# ENCYCLOPÆDIA BRITANNICA.

*A New Survey of Universal Knowledge*

Volume 1

A to ANNOY

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TO

HER MAJESTY
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AND

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BECAUSE utility was believed by the original editors, in 1768, and by subsequent editors, to be the "principal intention of every publication," the Britannica's progressive history has been one of expansion and enlargement, and the aim of the editors has been to sift the vast store of available knowledge and render its essential part accessible to all who read.

One difficulty has been to keep this essential part to a convenient and usable form. Times change, fresh information demands inclusion, and supplementary volumes added to old ones offer no adequate solution of the problem of keeping the reader abreast of the times; nor, indeed, do new editions solve the problem. Editions in the past have taken from three to fourteen years to make, and material in one volume was old before the next volume was made.

The matured three-point plan of continuous revision of the Britannica obviates these editorial difficulties.

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The reader can contribute much toward the economical use of the great quantity of material in this reference set by first turning to the index in Volume 24 when in search of information. The index is the direct guide to the many thousands of topics in the 43,500 entries, and the way to use it is described on pages v–ix in Volume 24.

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**C. A. R. N.—Cyril Alfred Rankin Nitch.** Fellow of the Royal College of Surgeons.

**C. A. Ro.—C. [illegible]. Robins.** Governor of Idaho, 1947–51.

**C. A. Sc.—Rev. Charles Anderson Scott, D.D.** Former Dunn Professor of the New Testament, Theological College of the Presbyterian Church of England

**C. A. Sp.—Charles A. Sprague.** Editor and Publisher, the *Oregon Statesman,* Salem, Ore.

**C. A. Ss.—Charles Anderson Stokes.** Director of Research and Development, Godfrey L. Cabot, Inc, Boston, Mass.

**C. B.—Cyril Bailey.** Jowett Lecturer, 1932–39, and Classical Tutor, 1902–39, of Balliol College, Oxford. Author of *Religion of Ancient Rome;* etc.

**C. Ba.—Christian Barman.** Fellow of the Royal Institute of British Architects Assistant Director, Post-War Building, Ministry of Works and Buildings, 1941–45 Author of *Sir John Vanbrugh; The Bridge;* etc

**C. Bau.—Catherine Bauer.** Vice-President, National Housing Conference Council Member, International Federation for Housing and Town Planning Author of *Modern Housing.*

**C. B. B.—Arthur C. Barrington Brown.** Consulting oil geologist.

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**C. B. Br.—Carl B. Boyer.** Professor of Mathematics, Brooklyn College, Brooklyn, N.Y Author of *The Concepts of the Calculus; A History of Analytic Geometry.*

**C. B. Bt.—Charles Barron Bisset.** Director, Geological Survey, Tanganyika.

**C. B. C.—Christopher Bush Coleman.** Director of Indiana State Historical Bureau, 1924–44, and of the State Library, 1936–42.

**C. B. de M.—Cecil Blount de Mille.** Playwright, actor and motion picture producer. Productions: *Ten Commandments; Cleopatra;* etc

**C. Be.—Charles Bennion.** Formerly of The British United Shoe Machinery Company Ltd, Leicester, England.

**C. Bem.—Charles Bémont.** Author of *Les Chartes des Libertés anglaises; Histoire de l'Europe au môyen age, de 395 à 1270;* etc.

**C. Bg.—Carl Berg.** Vice-President and Chief Engineer, Nickel Cadmium Battery Corporation, Easthampton, Mass

**C. B. H.—Charles Belknap Henderson.** Director (1934–47) and Chairman of the Board (1941–47), Reconstruction Finance Corporation, Washington, D.C.

**C. Bi.—Rev. Charles Bigg, D.D.** Regius Professor of Ecclesiastical History, Oxford, 1901–08. Author of *Neoplatonism;* etc.

**C. B. M.—Charles B. MacDonald.** Historian, Office of the Chief of Military History, Department of the Army, Washington, D C.

**C. Bn.—A. Curtis Brown.** Former President of Curtis Brown, Ltd, International Publishing Bureau, London and New York.

**C. B. N.—Charles B. Nutting.** Vice-Chancellor and Professor of Law, University of Pittsburgh, Pittsburgh, Pa. Co-author of *Cases and Materials on Legislation.*

**C. B. P.—Charles Benjamin Purdom.** Finance Director, Welwyn Garden City, Ltd., 1919–28 Author of *The Garden City;* etc.

**C B. Ph.—Catherine Beatrice Phillips.** Sometime Associate of Bedford College, University of London.

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**C. B. R.—Charles Bedell Rose.** President, American-La France and Foamite Corporation, New York, 1927–36 Former Vice-President, Baldwin Locomotive Works, Eddystone, Pa.

**C. B. Sn.—Chester Baker Slawson.** Professor of Mineralogy, University of Michigan, Ann Arbor, Mich Co-author of *Gems and Gem Materials*

**C. B. Sr.—Charles Baldwin Sawyer.** President, the Brush Laboratories Company, and Chairman, the Brush Beryllium Company, Cleveland, O.

**C. B. T.—C. B. Tracey.** Governor of Northern (Ed Damer) Province, Anglo-Egyptian Sudan.

**C. B. W.—C. B. Williams.** Chief Entomologist, Rothamsted Experimental Station, Harpenden, Herts, Eng, 1932– .

**C. C.—Charles Cestre.** Professor of American Literature and Civilization at the Sorbonne Author of *An Introduction to Edwin Arlington Robinson;* etc.

**C. Ca.—Clarence Cannon.** U.S. Congressman from Missouri, 1923–49 Author of *A Synopsis of the Procedure of the House;* etc.

**C. C. D.—Cuthbert Collin Davies.** Reader in Indian History, Oxford University Author of *The Problem of the North-West Frontier, 1890–1908; Warren Hastings and Oudh; An Historical Atlas of the Indian Peninsula;* etc

**C. Ch.—Cecil Chisholm.** Chairman of Business Publications, Ltd. Editor of *System.* Author of *Marketing and Merchandising.*

**C. Chr.—Charles Chree.** Superintendent, King's Observatory, Kew, England, 1893–1925.

**C. C. J. W.—Clement Charles Julian Webb.** Oriel Professor of the Philosophy of Christian Religion, Oxford University, 1920–30 Honorary Fellow of Oriel College and of Magdalen College, Oxford. Author of *In Time of War; Divine Personality and Human Life; History of Philosophy;* etc.

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**C. C. L.—Charles Christopher Lloyd, F.R.H.S.** Senior Lecturer, Royal Naval College. Greenwich, Eng. Author of *Captain Cook; Lord Cochrane; The Nation and the Navy;* etc.

**C. C. Le.—Clarence Cook Little.** Director, Roscoe B Jackson Memorial Laboratory, Bar Harbor, Me., 1929– . Managing Director, American Society for Control of Cancer, 1929–45. Author of *Civilization against Cancer.*

**C. C. M.—C. C. MacDuffee.** President, Mathematical Association of America, 1945–46 Author of *The Theory of Matrices;* etc.

**C. Com.—Christine Comber.** Foreign Research and Press Service, Royal Institute of International Affairs, London, 1941–43. Foreign Office, London, 1943–48.

**C. C. Pe.—Charles C. Price.** Professor of Chemistry, University of Notre Dame, Notre Dame, Ind Author of *Brief Course in Organic Chemistry; Reactions at the Carbon-Carbon Double Bond.*

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**C. C. Z.—Carle Clark Zimmerman.** Sociologist, Harvard University Author of *Family and Civilization; Graphic Regional Sociology.*

**C. Da.—Cyril James H. Davenport.** Major Former Superintendent of Bookbinding, British Museum, London. Author of *Cameos; Mezzotints;* etc.

**C. D. A.—Charles Dennis Adams.** Lecturer in Botany, University College of the Gold Coast, Achimota, Gold Coast.

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**C. D. Sn.—C. D. Stein, V.M.D.** Veterinarian, Pathological Division, Bureau of Animal Industry, Agricultural Research Administration, U.S. Department of Agriculture, Washington, D.C.

**C. D. T.—Carl Dean Thompson.** Former Director, Public Ownership League of America. Author of *Municipal Ownership; Public Ownership;* etc.

**C. E.—Charles Everitt.** Sometime Scholar of Magdalen College, Oxford.

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**C. E. H.—Charles Evans Hughes.** Chief Justice, Supreme Court of the United States, 1930–41. Secretary of State, 1921–25. Author of *Our Relation to the Nations of the Western Hemisphere;* etc.

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**C. E. Ke.—C. Edith Kerby.** Associate for Program Planning and Research, National Society for the Prevention of Blindness.

**C. E. K. M.—Charles Edward Kenneth Mees.** Director, Vice-President in Charge of Research, Eastman Kodak Company, Rochester, N.Y. Author of *The Fundamentals of Photography;* etc.

**C. El.—Sir Charles Norton Edgcumbe Eliot.** British Ambassador to Japan, 1919–26. Author of *Hinduism and Buddhism;* etc.

**C. E. L. C.—Charles E. L. Corthorn.** Assistant Manager and Secretary of the Ottoman Bank, 1911–28.

**C. E. Lu.—Cyril Edward Lucas.** Head of Department and Deputy Director of Research, Department of Oceanography, University College, Hull, Eng. Co-editor, *Hull Bulletins of Marine Ecology.*

**C. E. M.—Sir Charles Edward Mallet.** Secretary for Indian Students at the India Office, London, 1912–16. Author of *Herbert Gladstone, A Memoir;* etc.

**C. E. Mc.—Constantine Edward McGuire.** Economic adviser to private concerns and to governments. Author of *Germany's Capacity to Pay; Italy's International Economic Position.*

**C. E. Me.—Coyle E. Moore.** Dean of the School of Social Welfare, Florida State University, Tallahassee, Fla.

**C. E. N.—Charles Eliot Norton.** Editor of the *Orations and Addresses of George William Curtis;* etc.

**C. E. O'H.—Charles E. O'Hara.** Captain, U.S. Air Force. Instructor, Office of Special Investigations Training School, U S Air Force Co-author of *An Introduction to Criminalistics; Practical Photographic Chemistry.*

**C. E. P. B.—C. E. P. Brooks.** Former Honorary Secretary, Royal Meteorological Society.

**C. E. Pr.—Carl E. Pray.** Former Head, Department of History and Social Sciences, Michigan State Normal College, Ypsilanti, Mich.

**Ce. R.—Cecil Rowntree.** Former Consulting Surgeon to the Royal Cancer Hospital.

**C. E. R. S.—Charles Ely Rose Sherrington.** Secretary, British Railways Research Service.

**C. E. S.—Courtney Edward Stevens.** Tutor in Ancient History, Magdalen College, Oxford.

**C. Et.—Carl Eckart.** Associate Professor of Physics, The University of Chicago (on leave for government service).

**C. E. T.—Cecil Edgar Tilley.** Professor of Mineralogy and Petrology, Cambridge University, 1931–

**C. E. Ta.—Creassey Edward Cecil Tattersall.** Keeper, Department of Textiles, Victoria and Albert Museum, London (retired). Co-author of *Hand-Woven Carpets, Oriental and European;* etc.

**C. E. We.—Charles Edwin Weaver.** Professor of Palaeontology, University of Washington, Seattle, Wash.

**C. E. Wi.—Charles Edward Wilson.** Director, U.S. Office of Defense Mobilization, 1950–52. President, General Electric Company, 1940–50.

**C. F.—Cesare Foligno.** Professor of English, University of Naples, Italy, 1940– .

**C. F. A.—Charles Francis Atkinson.** Author, *The Wilderness and Cold Harbour.*

**C. F. A.-C.—Sir Charles Frederick Arden-Close.** Colonel. President, International Geographical Union, 1934–38. Author, *Text Book of Topographical Surveying;* etc.

**C. F. B.—Charles Francis Bastable.** Former Professor of Political Economy, Dublin University. Regius Professor of Laws, 1908–32. Author of *Theory of International Trade; Public Finance;* etc.

**C. F.-Br.—Sir Charles Fortescue-Brickdale.** Chief Registrar, Land Registry, 1900–23. Author of *Registration of Title to Land;* etc.

**C. F. C.—Charles Frederick Cross.** Analytical and consulting chemist. Co-author of *Researches on Cellulose; Text-Book of Paper-making.*

**C. Ff.—Charles John Ffoulkes.** Trustee of the Imperial War Museum, London, 1934–47. Author of *Armour and Weapons;* etc.

**C. F. F.—Carl F. Floe.** Professor of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass. Consulting metallurgist

**C. F. G.—Charles Francis Goldthwait.** Senior Cotton Technologist, Southern Regional Research Laboratory, U.S. Department of Agriculture, New Orleans, La., 1941– .

**C. F. Gu.—C. F. Gummer.** Professor of Mathematics at Queen's University, Kingston, Ont., Canada

**C. F. K.—Charles Fabens Kelley.** Curator of Oriental Art and Assistant Director of the Art Institute of Chicago

**C. F. Ke.—Charles Franklin Kettering.** Vice-President and Director, Charles F. Kettering Foundation, Inc.

**C. Fl.—Carl Flink.** Mechanical Engineer, American Radiator and Standard Sanitary Corporation, New York, N Y.

**C. F. L.-H.—Carl F. Lehmann-Haupt.** Former Professor of Ancient History in the University of Innsbruck, Austria

**C. F. Lo.—C. Frances Loomis.** Former Director of Program, Camp Fire Girls, Inc

**C. F. Ls.—Charles F. Lewis.** Director, the Buhl Foundation, Pittsburgh, Pa.

**C. F. McK.—Charles F. McKhann, M.D.** National Medical Director, United Cerebral Palsy Associations, Inc.

**C. F. R.—Sir Charles Fernand Rey.** Lieutenant Colonel Commander of the Star of Ethiopia, 1924 Author of *Unconquered Abyssinia as It Is Today;* etc.

**C. F. St.—Carl Frederic Schmidt, M.D.** Professor of Pharmacology, University of Pennsylvania, Philadelphia, Pa. Co-author of *Ephedrine and Related Substances;* co-editor, J. J. Macleod, *Physiology in Modern Medicine.*

**C. Fu.—Clyde Furst.** Former Secretary, Carnegie Foundation for the Advancement of Teaching.

**C. G.—Charles Gide.** Former Professor at the Collège de France, Paris.

**C. Ga.—Clement Gatley.** Author of *The Law and Practice of Libel and Slander in a Civil Action;* etc.

**C. G. A.—Charles Greeley Abbot.** Research Associate, Smithsonian Institution, Washington, D.C Director of the Smithsonian Astrophysical Observatory, 1907–44. Author of *The Sun;* etc.

**C. G. C.—Sir Charles Gibson Connell.** Senior Partner, Connell and Connell, Writers to the Signet, Edinburgh, Scot. Author of *Agricultural Holdings (Scotland) Acts.*

**C. Gd.—Calvin Goddard.** Colonel, U.S. Army, retired.

**C. G. D.—Sir Charles Galton Darwin.** Director of National Physical Laboratory, Teddington, Eng Tait Professor of Natural Philosophy in Edinburgh University Scot., 1923–36. Author of *The New Conceptions of Matter;* etc

**C. G. F.—Colin Garfield Fink.** Professor of Chemical Engineering, Head of Division of Electrochemistry, Columbia University, 1922–50. Invented ductile tungsten filament and electrochemical restoration of ancient bronzes.

**C. G. F. S.—Colin George Frederick Simkin.** Professor of Economics, Auckland University College, Auckland, N Z. Author of *The Instability of a Dependent Economy.*

**C. G. Gr.**—**Constantine G. Grand.** Research Associate, Laboratory of Cellular Physiology, New York University.

**C. G. H.**—**Clay G. Huff.** Chief Parasitologist, National Research Institute, Bethesda, Md., 1947– . Co-author of *Parasitology;* author of *A Manual of Medical Parasitology.*

**C. Gi.**—**Cedric Gibbons.** Art Director, Metro-Goldwyn-Mayer Studios, Culver City, Calif., 1924– .

**C. G. P.**—**Carl G. Paulsen.** Chief Hydraulic Engineer, Geological Survey, U.S. Department of the Interior.

**C. Gr.**—**Charles Gross.** Professor of History at Harvard University, 1888–1909. Author of *The Gild Merchant.*

**C. G. Ro.**—**Sir Charles Grant Robertson.** Principal, Birmingham University, Birmingham, Eng., 1920–38 Author of *England under the Hanoverians;* etc.

**C. Gs.**—**Clifford Goes.** Member of U.S Olympic Committee.

**C. G. S.**—**Charles Gabriel Seligman, M.D.** Former Professor of Ethnology, University of London

**C. G. T.**—**C. Gordon Tether.** Money Market Editor, the *Financial Times,* London

**C. G. W.**—**Carter Godwin Woodson.** Former Editor of *Journal of Negro History*

**C. H.**—**Charles Hose.** Member of the Sarawak State Advisory Council at Westminster, London, 1919.

**C. H. A.**—**Charles Henry Ambler.** Emeritus Professor of History, West Virginia University, Morgantown, W.Va Author of *History of Transportation in the Ohio Valley; Francis H. Pierpont.*

**C. H. B.**—**Charles Herbert Best, M.D.** Director of Banting-Best Department of Medical Research, University of Toronto, Canada, 1941– . Co-discoverer of insulin, 1921.

**C. H. Be.**—**Charles H. Behre, Jr.** Professor of (Economic) Geology, Columbia University, New York, N Y Member of Behre, Dolbear, and Company, consulting geologists and mining engineers, New York, N.Y.

**C. H. Br.**—**Sir Charles Herbert Bressey.** Principal Technical Officer, British Ministry of Transport, 1928–35

**C. H. C.**—**Charles Herbert Colvin.** Director, Daniel Guggenheim School of Aeronautics, New York University, 1941–44.

**C. H. C. B.**—**Charles H. Collins Baker.** Research in Art History, Huntington Library, Calif Author of *British Painting;* etc.

**C. H. Cn.**—**C. H. Curran.** Curator, American Museum of Natural History, New York, N Y. Author of *Families and Genera of North American Diptera;* etc.

**C. H. Cr.**—**Charles Howard Crane.** Architect, designer of Music Box and Guild Theatres, New York, N.Y., etc.

**C. H. D.**—**Charles H. Dennis.** Former Editor of the *Chicago Daily News.*

**C. H. F.**—**Clarence Henry Faust.** Dean of Humanities and Sciences and Professor of English, Stanford University, Stanford, Calif. Co-author of *Jonathan Edwards.*

**C. H. H.**—**Carlton Joseph Huntley Hayes.** Seth Low Professor of History in Columbia University Author of *Historical Evolution of Modern Nationalism;* etc.

**C. H. Hr.**—**Chester Henry Houser.** Curator of the Embryological Collection, Department of Embryology, Carnegie Institution of Washington, Baltimore, Md.

**C. H. K.**—**Clarence Hill Kelsey.** Former Chairman of the Board of Title Guarantee and Trust Company

**C. H. K. B.**—**The Rev. Canon Charles Henry Knowler Boughton.** Former Vicar of Saint John the Baptist, Knighton.

**C. H. Ky.**—**Clarence Hamilton Kennedy.** Professor of Zoology and Entomology Ohio State University, Columbus, Ohio Author of *Manual for the Study of the Internal Anatomy of Insects.*

**C. H. L.**—**Cecil H. Lander.** Professor of Engineering at Imperial College, London, 1931–46.

**C. H. LaW.**—**Charles H. LaWall.** Former Dean, Philadelphia College of Pharmacy and Science, Philadelphia, Pa

**C. H. L. J.**—**Charles Haven Ladd Johnston.** Author of *Famous Cavalry Leaders;* etc

**C. H. M.**—**Conrad Henry Moehlman.** Visiting Professor, School of Religion, University of Southern California, Los Angeles, Calif Author of *The Christian-Jewish Tragedy; Protestantism's Challenge; School and Church: The American Way; The Wall of Separation Between Church and State;* etc

**C. Ho.**—**Sir Charles Holroyd.** Director, National Gallery, London

**C. Hol.**—**Carl Hollweg.** Admiral. Former Director of Department in German Admiralty (Reichsmarineamt) Author of *Unser Recht auf dem U-Bootskrieg*

**C. Hos.**—**Constance Hoster.** Former Principal of Secretarial Training College for Educated Girls and Women, London. Author, with Ellen, Countess of Desart, of *Style and Title*

**C. H. P.**—**Charles Herman Pritchett.** Professor and Chairman of the Department of Political Science, The University of Chicago Author of *The Tennessee Valley Authority.*

**C. H. R.**—**Charles H. Reilly.** Former Professor of Architecture, University of Liverpool, England

**C. H. Rn.**—**Charles Howard Richardson.** Professor of Entomology, Iowa State College, Ames, Ia.

**C. H. T.**—**Crawford Howell Toy.** Former Professor of Hebrew and Oriental Languages, Harvard University.

**C. H. Tu.**—**Cuthbert Hamilton Turner.** Grinfield Lecturer on the Septuagint, 1925–27. Author of *Studies in Early Church History;* etc.

**C. H. Tut.**—**Charles H. Tuttle.** Member of the Board of Higher Education of the City of New York. Member of Special Committee of National Crime Commission, 1927– .

**C. H. van T.**—**Claude Halstead van Tyne.** Former Head of Department of History, University of Michigan, Ann Arbor, Mich. Author of *Causes of the War for Independence;* etc.

**C. H. V. S.**—**Charles Humphrey Vivian Sutherland.** Student of Christ Church, Oxford Author of *Coinage and Currency in Roman Britain; Coinage in Roman Imperial Policy; The Romans in Spain.*

**C. H. W.**—**Camilla H. Wedgwood.** Principal of Women's College, University of Sydney, Austr., 1935–44.

**C. J.**—**Charles James.** Former Professor of Chemistry, University of New Hampshire, Durham, N.H.

**C. J. B.**—**Charles Jasper Blunt.** Colonel, R A O C. Served in World War I at Gallipoli

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**C. J. Ff.**—**Constance Jocelyn Ffoulkes.** Translator of Morelli's *Italian Painters;* etc.

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**C. J. G.**—**Cyril John Gadd.** Deputy Keeper, Egyptian and Assyrian Antiquities, British Museum, London.

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**C. J. J. F.**—**Charles J. J. Fox.** Former Principal of Physical Chemistry, Royal Institute of Science, Bombay, India.

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**C. Joh.**—**Charles Johnston.** Bengal Civil Service (retired). Orientalist, author and student of bird life.

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**C. K. H.**—**Charles Kenneth Hobson.** Author of *The Export of Capital.*

**C. K. O.—Charles Kay Ogden.** Originator of Basic English. Organizer of the Orthological Institute, London. Founder, Basic English Foundation.

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**C. K. W.—Charles Kingsley Webster.** Stevenson Professor of International History, London School of Economics, 1932– . Preparatory Commission to General Assembly, UN, London, 1945–46 Author of *British Diplomacy, 1813–1915;* etc

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**C. L. Bo.—Charles L. Bolte.** Major General. Director of Plans and Operations, General Staff, Department of the Army, Washington, D C.

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**C. L. F.—C. L. Ferguson.** Former Assistant Clerk, House of Commons, London.

**C. L. Fe.—Carroll Lane Fenton.** Author of *Our Amazing Earth;* co-author of *The Rock Book; Story of the Great Geologists.*

**C. L. Gn.—Charles Lewis Gazin.** Curator of Vertebrate Palaeontology, U.S. National Museum, Smithsonian Institution, Washington, D.C.

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**C. Li.—Caldwell H. Lipsett.** Former Editor, *Civil and Military Gazette,* Lahore, India.

**C. L. K.—Charles Lethbridge Kingsford.** Assistant Secretary, Board of Education, London, 1905–12. Author of *Life of Henry V.*

**C. Ll. M.—Conwy Lloyd Morgan.** Former Professor of Zoology and Geology, University College, Bristol, England. Author of *Introduction to Comparative Psychology;* etc.

**C. L. P.—C. L. Patton.** Former President of the American Whist League.

**C. L. St.—C. L. Stewart.** Professor of Agricultural Economics and Chief in Land Economics, University of Illinois, Urbana.

**C. L. T.—Charles Lamar Thomas.** Associate Director of Research, Sun Oil Co., Marcus Hook, Pa.

**C. L. V. M.—Carroll L. V. Meeks.** Associate Professor of Architecture and the History of Art, Yale University.

**C. L. W.—Charles Leslie Wrenn.** Rawlinson and Bosworth Professor of Anglo-Saxon, Oxford University Fellow of Pembroke College, Oxford Author of *Beowulf,* an edition; *The English Language.*

**C. L. Wn.—Carl Louis Wilson.** Professor of Botany, Dartmouth College, Hanover, N.H.

**C. M.—Christopher Morley.** Author of *The Haunted Book Shop; Chimneysmoke; Inward Ho!; Thunder on the Left;* etc.

**C. Ma.—Charles Marriott.** Art Critic, *The Times,* London, 1924–40. Author of *Modern English Architecture;* etc.

**C. M. A.—C. M. Austin.** Commander, USN. Formerly stationed at Washington, D.C.

**C. Mas.—Charles Masson.** Conservateur Musée du Luxembourg.

**C. M. Ay.—Cecilia Mary Ady.** Honorary Fellow, St. Hugh's College, Oxford Author of *The Bentivoglio of Bologna; Milan Under the Sforza; Morals and Manners of the Quattrocento; Pope Pius II.*

**C. M. Br.—C. M. Breder, Jr.** Chairman and Curator, Department of Fishes and Aquatic Biology, the American Museum of Natural History, New York, N.Y. Author of *Field Book of Marine Fishes of the Atlantic Coast.*

**C. M. Cd.—Charles Manning Child.** Emeritus Professor of Zoology, The University of Chicago.

**C. M. Cl.—Constance Margaret Cornell.** Diplomatic Correspondent, *The Glasgow Herald.*

**C. M. Cr.—Charles M. Carpenter, M.D.** Professor and Chairman of the Department of Infectious Diseases, School of Medicine, University of California, Los Angeles, Calif.

**C. M. Cs.—Cecil Marvin Charles, M.D.** Associate Professor of Anatomy, Washington University, St. Louis, Mo.

**C. M. Cy.—Clifford M. Carey.** Director of Research, National Council of the Young Men's Christian Associations, New York, N.Y. Author of *Between Two Centuries.*

**C. M. D.—Carlton Miles Dean.** Assistant Manager, Engineering Sales, Monsanto Chemical Company, St. Louis, Mo.

**C. M. E. M.—Charles Marie Emmanuel Mangin.** General Commanding the French V, VI and X Armies, 1916–18, and the French forces in Rhineland, 1918–19.

**C. M. H.—Charles Meyer Hardin.** Assistant Professor of Political Science, The University of Chicago.

**C. M. H. C.—Charles Manning Hope Clark.** Professor of History, Canberra University College, Canberra, Austr. Editor of *Select Documents in Australian History, 1788–1850.*

**C. Mi.—Carl Theodor Mirbt.** Former Professor of Church History in the University of Marburg, Germany. Author of *Publizistik im Zeitalter Gregor VII; Quellen zur Geschichte des Papstthums;* etc.

**C. Mij.—Chedomille Mijatovich.** Former Senator of the Kingdom of Serbia Serbian Minister to the Court of St. James's, 1895–1900 and 1902–03. Author of *Serbia and the Serbians;* etc.

**C. M. J.—Rev. Charles Michael Jacobs, D.D.** Former Professor of Church History and President of the Graduate School, Lutheran Theological Seminary, Philadelphia, Pa. Editor of *Luther's Correspondence.*

**C. M. K.—Sir Charles Malcolm Kennedy.** Head of Commercial Department, Foreign Office, 1872–93.

**C. M. Kn.—C. M. Knowles.** Former Assistant Legal Adviser, Home Office, London.

**C. M. L.—Charles Mostyn Lloyd.** Lecturer and Head of the Department of Social Science and Administration in the London School of Economics and Political Science, University of London, Assistant Editor of *The New Statesman.*

**C. Mn.—Colin Matheson.** Keeper, Department of Zoology, National Museum of Wales, Cardiff, Wales Author of *Changes in the Fauna of Wales; Wales and the Sea Fisheries.*

**C. Mo.—Herbert Clifford Mortimer.** Barrister-at-Law, Probate and Divorce Court, London.

**C. Mon.—William Cosmo Monkhouse.** English poet and art critic. Author of *The Italian Pre-Raphaelites; Life of Turner;* etc.

**C. M. P.—Sir Charles Max Page.** Fellow of the Royal College of Surgeons, London. Author of *The Treatment of Fractures in General Practice;* etc.

**C. M. S.—Cecil M. Smith.** Editor, *Musical America.* Author of *Musical Comedy in America.*

**C. M. Tr.—Carlisle Monroe Thacker.** Solvay Process Corporation, Hopewell, Va.

**C. N. E.—Carl N. Everstine.** Research Assistant, Maryland Legislative Council.

**C. N. G.—C. Norman Guice.** Formerly on faculty of Stephens College, Columbia, Mo.

**C. N. H.—Clarence N. Hickman.** Research Physicist, Bell Telephone Laboratories, Inc., New York, N.Y.

**C. N. P.—Cyril Northcote Parkinson.** Raffles Professor of History, University of Malaya, Singapore. Author of *Trade in the Eastern Seas; War in the Eastern Seas (1793–1815).*

**Co. B.—Cornelius Betten.** Emeritus Professor of Entomology, Cornell University, Ithaca, N.Y. Author of *The Caddis Flies, or Trichoptera of New York State;* etc.

**C. O. B.—Charles Otto Blagden.** Dean, School of Oriental Studies, London, 1922–35.

**Co. C.—Colin Carmichael.** Editor, *Machine Design.*

**C. O. F.—Charles Owen Fairchild.** President, The Instrument Society of America. Co-author of *Pyrometric Practice.*

**C. O. G.—Charles O. Gregory.** Professor of Law, University of Virginia, Charlottesville, Va. Author of *Labor and the Law;* co-author of *Labor Law: Cases, Materials and Comments.*

**C. P.—Rev. Charles Plummer.** Former Fellow and Chaplain of Corpus Christi College, Oxford. Author of *Life and Times of Alfred the Great.*

C. Pa.—**Cesare Paoli.** Italian historian. Former Editor of *Archivio storico italiano*

C. P. B.—**Charles Paul Boner.** Associate Director, Underwater Sound Laboratory, Harvard University Author of *Laboratory Manual on General Physics;* etc

C. Pe.—**Charles Palache.** Emeritus Professor of Mineralogy, Harvard University. Co-author of *Dana's System of Mineralogy.*

C. Pf.—**Christian Pfister.** Former Professor at the Sorbonne, Paris Author of *Étude sur le règne de Robert le Pieux;* etc

C. P. I.—**Sir Courtenay Peregrine Ilbert.** Former Clerk of the House of Commons and Chairman of Statute Law Committee.

C. P. L.—**Rev. Charles Patrick Loughran, S.J.** Professor of Classics, St. Andrew on Hudson, Poughkeepsie, N.Y

C. P.-li.—**Chen Pu-lai.** Secretary to Chiang Kai-shek. Former Editor, *Shang Pao* and *China Times*

C. Pn.—**Charles Parmin.** Honorary Teacher of English, Lycée Marcel Gambier, Lisieux, Fr

C. P. N.—**Charles P. Nash, Jr.** Professor of Law, University of Virginia, Charlottesville, Va.

C. P. O.—**Charles P. Olivier.** Director of Flower Observatory and Cook Observatory, University of Pennsylvania, Philadelphia, Pa. Author of *Meteors;* etc.

C. P. S.—**Clifford P. Smith.** Former Editor, Department of History of The First Church of Christ Scientist, Boston, Massachusetts.

C. P. Sa.—**Charles Percy Sanger.** Formerly of Lincoln's Inn, Barrister-at-Law.

C. P. Sy.—**Charles Perry Stacey.** Colonel, Canadian Army. Director, Historical Section, Army Headquarters, Ottawa, Ont Author of *Canada and the British Army; The Canadian Army,*

C. P. W.—**Charles P. Wood.** Industrial Engineer, Lockwood Greene Engineers, Inc, New York, N.Y. Author of *Factors Controlling the Location of Various Types of Industry.*

C. P. Y.—**Constantin Prodomos Yaglou.** Associate Professor of Industrial Hygiene, Harvard University School of Public Health, 1938– .

C. R.—**Cecil Roth.** Reader in Post-Biblical Jewish Studies, Oxford University, 1939– . Author of *The Last Florentine Republic;* etc.

C. Ra.—**Cornelia M. Raymond.** Former Director, Bureau of Publications, Vassar College, Poughkeepsie, N.Y.

C. R. Al.—**Carl R. Addinall.** Foreign Scientific Adviser of Merck & Co., Inc., Rahway, N.J. Author of *Story of Amino Acids.*

C. R. B.—**Sir Charles Raymond Beazley.** Emeritus Professor of History, Birmingham University, England. Co-author of *History of Russia;* author of *Nineteenth Century Europe;* etc.

C. R. Bn.—**Charles Ridgaway Bragdon.** Consulting Chemical Engineer, Larchmont, N.Y.

C. R. Br.—**Rev. Charles Reynolds Brown, D.D.** Former Dean, the Divinity School, Yale University, New Haven, Conn. Author of *The Modern Man's Religion;* etc.

C. Re.—**Charles Reitell.** Partner, Stevenson, Jordan and Harrison, Inc., management engineers, New York, N.Y.

C. R. Fi.—**Carl Russell Fish.** Former Professor of American History, University of Wisconsin, Madison, Wis. Author of *American Diplomacy;* etc.

C. R. Gy.—**Carl Raymond Gray, Jr.** Administrator of Veterans' Affairs, Veterans Administration, Washington, D.C., 1947–53.

C. R. H.—**C. R. Houseman.** Of the British Oxygen Company Ltd, Research Laboratory, Middlesex, Eng

C. Ric.—**Corrado Ricci.** Former President of the Royal Institute of Archaeology and History of the Arts. Author of *Il Correggio;* etc

C. R. K.—**Charles Richard Knappett, M.D.** Lecturer, Department of Bacteriology St. Mary's Hospital Medical School, London

C. R. Me.—**Carl Richard Moore.** Professor of Zoology, The University of Chicago

C. Rn.—**Chaim Rabin.** Cowley Lecturer of Post-Biblical Hebrew, Oxford University Author of *Ancient West-Arabian; The Zadokite Documents.*

C. R. N.—**Carl Robert Noller.** Professor of Chemistry, Stanford University, Stanford. Calif.

C. R. P.—**Chesley R. Perry.** President, Rotary Club of Chicago, Ill, 1944–45.

Cr. R.—**Chester Rapkin.** Research Associate, Institute for Urban Land Use and Housing Studies, Columbia University, New York, N.Y. Author of *Housing Market Analysis;* co-author of *Urban Traffic.*

C. R. Ro.—**Clarence Rufus Rorem.** Executive Director, Hospital Council of Philadelphia, Philadelphia, Pa Author of *The Public's Investment in Hospitals; Private Group Clinics;* etc.

C. R. S.—**C. Richard Soderberg.** Dean of Engineering. Massachusetts Institute of Technology, Cambridge, Mass.

C. R. Wy.—**Charles R. Whittlesey.** Professor of Finance and Economics, University of Pennsylvania, Philadelphia, Pa Economist, the Penn Mutual Life Insurance Company. Author of *International Monetary Issues.*

Cs. B.—**Carlos Baker.** Chairman, Department of English, Princeton University, Princeton, N.J. Author of *Hemingway: the Writer as Artist; Shelley's Major Poetry.*

C. S. B.—**Charles S. Braden.** Professor and Chairman of the Department of History and Literature of Religions, Northwestern University, Evanston, Ill. Author of *Modern Tendencies in World Religions; Religious Aspects of the Conquest of Mexico;* etc.

C. Se.—**Charles Seignobos.** Former Professor, Faculty of Letters, Sorbonne, Paris. Author of *The Rise of European Civilization.*

C. Sey.—**Charles Seymour.** President, Yale University, 1937–50 Author of *The Diplomatic Background of the War;* etc.

C. S. F.—**Sir Cyril Sankey Fox.** Director, Geological Survey, India, 1939–43.

C. S. G.—**Charles Stuart Gager.** Director, Brooklyn Botanic Garden, Brooklyn, N.Y., 1910–43. Author of *Fundamentals of Botany;* etc.

C. S. H.—**Cornelius Searle Hurlbut, Jr.** Associate Professor of Mineralogy, Harvard University. Co-author of *Manual of Mineralogy; Minerals and How to Study Them.*

C. Si.—**Charles Singer, M.D.** Emeritus Professor of the History of Medicine, University of London. Author of *Greek Biology and Greek Medicine;* etc.

C. Sk.—**Clifford Strock.** Editor, *Heating and Ventilating.*

C. S. K.—**Clarence Selby Kempff.** Rear Admiral, U.S. Navy (retired) Former Hydrographer, Bureau of Navigation, Navy Department, Washington, D.C.

C. S. Kr.—**Chester Scott Keefer, M.D.** Wade Professor of Medicine, Boston University School of Medicine.

C. S. L.—**Charles Sumner Lobingier.** Securities and Exchange Commission Officer, 1934–46 Author of *The Beginnings of Law; Extraterritorial Cases;* etc.

C. S. P.—**Rev. Charles Stanley Phillips.** Formerly of King's College, Cambridge. Gladstone Memorial Prize, 1904.

C. S. Pa.—**Rt. Hon. Charles Stuart Parker.** Author of *Life of Sir Robert Peel;* etc.

C. Sr.—**Charles Sawyer.** Secretary, U.S. Department of Commerce, Washington, D.C.

C. S. R.—**C. Stanford Read, M.D.** Lecturer in Psychological Medicine, Bethlem Royal Hospital, and Clinical Psychologist to the West End Hospital for Nervous Diseases, London. Author of *The Struggles of Male Adolescence;* etc.

C. S. Ri.—**Clarence Self Ridley.** General. Governor of the Panama Canal Zone, 1936–40.

C. S. Rs.—**Carl S. Roys.** Professor of Electrical Engineering, University of Massachusetts, Amherst, Mass.

C. S. S.—**Sir Charles Scott Sherrington, M.D.** Former Waynflete Professor of Physiology, Oxford University. Nobel Prize for Medicine, 1932. Author of *The Integrative Action of the Nervous System;* etc.

C. St.—**Constantine Stanislavsky.** Russian theatrical producer. Founded, with V. N. Danchenko, the Moscow Art Theatre. Author of *My Life in Art.*

C. Str.—**Carl Stripe.** Manager, Stoker Division, Combustion Engineering Company, Inc., New York, N.Y.

C. T. B.—**Clinton T. Bissell.** Associate Consulting Engineer, National Board of Fire Underwriters, New York, N.Y.

C. T. Bs.—**Charles Thomas Brues.** Emeritus Professor of Entomology, Harvard University. Author of *Insects and Human Welfare;* etc.

C. T. C.—**Sir Cecil T. Carr.** Editor of *Statutory Rules and Orders,* 1923–43. Author of *Law of Corporations;* etc.

C. Te.—**Sir Charles Bruce Locker Tennyson.** Former Deputy Director of the Federation of British Industries.

C. T. H.—**Charles T. Haven.** Co-author of *The History of the Colt Revolver* and *Automatic Arms, Their History, Development and Use.*

C. T. H. W.—**Sir Charles Theodore Hagberg Wright.** Former Librarian and Secretary of the London Library.

C. T. O.—**Charles Talbut Onions.** Reader in English Philology, Oxford University, 1927– . Joint Editor, *Oxford English Dictionary,* 1914–33.

C. T. R.—**C. Tate Regan.** Director, British Museum (Natural History), London, 1927–38. Author of *British Freshwater Fishes;* etc.

C. V. C.—**Chester V. Clifton.** Colonel, U.S. Army. Assistant to the Chairman, Joint Chiefs of Staff, Washington, D.C.

**C. V. D.—Charles Vickery Drysdale.** Director of Scientific Research, Admiralty, 1929–34.

**C. V. U.—Cecil Vivian Usborne.** Vice-Admiral, formerly with Royal Navy. Author of *The Conquest of Morocco; Smoke on the Horizon.*

**C. W.—Charles Wright.** Of Messrs. Henry Head and Company, Ltd., Brokers, London. Co-author of *A History of Lloyd's.*

**C. Wa.—Sir Charles Walston.** Former Slade Professor of Fine Art, Cambridge University. Author of *Greek Sculpture and Modern Art.*

**C. Was.—Carleton Wolsey Washburne.** Superintendent of Winnetka, Ill., schools, 1919–45. Author of *Adjusting the School to the Child;* etc.

**C. W. B.—Carl W. Bishop.** Associate Curator of the Freer Gallery of Art, Smithsonian Institution, 1922–42.

**C. W. Be.—Clarence W. Balke.** Research Director, Fansteel Metallurgical Corporation, North Chicago, Ill., 1916–48.

**C. W. C. O.—Sir Charles William Chadwick Oman.** Member of Parliament for Oxford University, 1919–35. Author of *A Short History of England.*

**C. W. D.—C. W. Dannatt.** Lecturer in Assaying, Imperial College of Science and Technology, London.

**C. W. Da.—Christopher William Dawson.** Barrister-at-Law. British Colonial Administrative Service (retired).

**C. We.—Cecil Weatherly.** Former Scholar of Queen's College, Oxford.

**C. W. E.—Charles William Eliot.** President of Harvard University, 1869–1909.

**C. W. Ee.—C. Wesley Eisele, M.D.** Associate Professor of Medicine, University of Colorado School of Medicine, Boulder, Colo.

**C. W. F. N.—(Cuthbert) Wilfrid Francis Noyce.** Master at Charterhouse School, Godalming, Surrey, Eng. Writer. Member of Mount Everest Expedition, 1953. Author of *Mountains and Men; Scholar Mountaineers; South Col.*

**C. W. G.—Claude William Guillebaud.** Lecturer in Economics, Cambridge University.

**C. W. Gm.—Cornelius W. Gillam.** Assistant Professor of Business Law, School of Business, The University of Chicago. Author of *A Casebook of Law and Business; A Textbook of Law and Business.*

**C. W. H.—Charles Wilson Hackett.** Professor of Latin-American History, University of Texas. Austin, Tex. Author of *The Mexican Revolution and the United States (1910–1926).*

**C. W. He.—Charles W. Hinkle.** Major, U.S. Air Force. Office, Secretary of Defense, Washington, D.C.

**C. W. M.—C. W. Metz.** Professor of Zoology and Director of the Zoological Laboratory, University of Pennsylvania, Philadelphia, Pa.

**C. W. Mr.—Clarence Weinert Muehlberger.** Toxicologist, Michigan Department of Health, Lansing, Mich.

**C. W. N.—Chester William Nimitz.** Commander in Chief, Pacific Fleet, 1941–45.

**C. Wr.—Clark Wissler.** Consulting Anthropologist, Bishop Museum, Honolulu, Haw., 1920–47. Author of *The American Indian;* etc.

**C. W. R.—Rev. Charles W. Reinhardt, S.J.** Professor of History and German, St. Andrew-on-Hudson, Poughkeepsie, N.Y. Author of *An Outline of Roman History.*

**C. W. Ro.—Sir Charles Walker Robinson.** Major General. Governor and Secretary, Royal Military Hospital, Chelsea, 1895–98. Author, *Strategy of the South African War;* etc.

**C. W-Sh.—Cecil Woodham-Smith.** Author of *Florence Nightingale; The Reason Why.*

**C. W. T.—Charles Warren Thornthwaite.** Director, Laboratory of Climatology, The Johns Hopkins University, Seabrook, N.J. Former Principal Climatologist, U.S. Soil Conservation Service, Washington, D.C. Author of *Internal [illegible] the United States;* etc.

**C. Wtr.—Charles Winter.** Barrister-at-Law, Gray's Inn, London

**C. W. W.—Sir Charles William Wilson.** Former British Commissioner on the Servian Boundary Commission. Author of *From Korti to Khartum;* etc.

**C. Z.—Carl Zeisberg.** President, U.S. Table Tennis Association.

**C. Z. K.—Charles Z. Klauder.** Former Consulting Architect, Harkness Memorial Dormitories, Yale University.

**D. A.—Sir David Anderson.** Former senior partner in the firm of Mott, Hay and Anderson, consulting engineers.

**D. A. D.—Dorothy Anne Dondore.** Former Professor of English Literature, William Woods College, Fulton, Mo. Author of *Four Centuries of Description;* etc.

**D. A. Gd.—David Alexander Guild.** Sheriff-Substitute of Lanarkshire at Glasgow, Scot. Author of *The Law of Arbitration in Scotland.*

**D. A. G. R.—Donald A. G. Reid.** Principal, Brixton School of Building, London. Author of *Building Science.*

**D. A. H.—Daniel Andreas Haakonsen.** Lecturer in Norwegian Literature, University of Oslo, Oslo, Nor. Author of *Skabelsen i Henrik Weyelands diktning.*

**D'A. Mc.—D'Arcy McNickle.** Director, Branch of Tribal Relations, Bureau of Indian Affairs, U.S. Department of the Interior, Washington, D.C. Author of *The Surrounded; They Came Here First.*

**D. A. P.—Douglas Archibald Porteous.** Deputy Government Actuary, London. Author of *Pension and Widow's and Orphan's Funds.*

**D. A. S.—Damon Alvin Spencer.** In Charge, Sheep, Goats, and Animal Fibers, Bureau of Animal Industry, U.S. Department of Agriculture, Washington, D.C. Author of *Factors That Influence Wool Production of Range Rambouillet Sheep;* etc.

**D. A. W.—David Alec Wilson.** Author of *The Truth about Carlyle; Carlyle till Marriage; Carlyle at His Zenith;* etc.

**D. B.—David Baxandall.** Former Deputy Keeper of the Science Division, Science Museum, South Kensington, London.

**D. Bea.—Donald Bear.** Former Director, Santa Barbara Museum of Art, Santa Barbara, Calif. Author of *Russell Cowles; Prelude.*

**D. Bh.—Douglas Bush.** Professor of English, Harvard University.

**D. B. K.—David Ballin Klein.** Professor of Psychology, University of Texas, Austin, Tex. Author of *General Psychology.*

**D. B. M.—Duncan Black MacDonald, D.D.** Professor of Semitic Languages, Hartford Theological Seminary, 1893–1933. Author of *Development of Muslim Theology, Jurisprudence and Constitutional Theory;* etc.

**D. B. Mh.—Dorothy B. Marsh.** Good Housekeeping Institute, New York, N.Y.

**D. B. Mn.—Dean B. McLaughlin.** Professor of Astronomy, University of Michigan, Ann Arbor, Mich.

**D. Br.—Dirk Brouwer.** Director of the Observatory, Yale University. Editor of the *Astronomical Journal.*

**D. Bru.—David Brunt.** Professor of Meteorology, Imperial College of Science and Technology, London, 1934– . Author of *[illegible] for Everybody;* etc.

**D. B. S.—David Barnard Steinman.** Founder, President, 1934–36, National Society of Professional Engineers. Author of *A Practical Treatise on Suspension Bridges, Their Design, Construction, and Erection;* etc.

**D. C.—Sir David Thomas Chadwick.** Secretary of the Imperial Economic Committee, 1927–46.

**D. C. Br.—Dorrance Crawford Bronson.** Actuary, The Wyatt Company, Washington, D.C.

**D. C. C.—Delmer Clair Cooper.** Associate Professor of Genetics, University of Wisconsin, Madison, Wis.

**D. C. Cr.—Donald C. Cutter.** Instructor in History, San Diego State College, San Diego, Calif.

**D. C. H.—Daniel Clarence Holtom.** Haskell Lecturer, The University of Chicago, 1940. Professor, Theology Department, Aoyama Gakuin, Tokyo, 1936–40. Author of *The National Faith of Japan; Modern Japan and Shinto Nationalism;* etc.

**D. C. M.—Dana C. Munro.** Former Professor of Mediaeval History, Princeton University. Author of *Middle Ages; A Source Book of Roman History;* Co-author, *Essays on the Crusades.*

**D. C. McD.—D. Clay McDowell.** Executive Secretary, Institute of Tropical Meteorology, University of Puerto Rico, Río Piedras, P.R.

**D. C. McM.—Douglas C. McMurtrie.** National Editor of *American Imprints Inventory,* 1937–41. Author of *The Golden Book; American Type Design;* etc.

**D. Co.—Dorothy Cocks.** Director of Advertising for the Marinello Company, New York, N.Y. Author of *The Etiquette of Beauty.*

**D. Coc.—Douglas Bennett Cockerell.** Former partner of Douglas Cockerell and Son, Bookbinders. Author of *Bookbinding and the Care of Books;* etc.

**D. C. Pe.—Dorothy Constance (Mrs. C. S.) Peel.** Former Departmental Editor of *Queen.* Former Editor of *Hearth and Home* and *Woman.* Author of *My Own Cookery Book;* etc.

**D. Cr.—Douglas Colyer.** Air Marshal. Civil Air Attaché to British Embassies at Paris, Brussels, The Hague and Rome, 1947– .

**D. C. S.—Rev. Professor David Capell Simpson, D.D.** Oriel Professor of Interpretation of Holy Scripture, Oxford University, 1925– . Canon of Rochester Cathedral.

**D. C. Sh.—David Clyde Smith.** Professor of Agronomy, University of Wisconsin, Madison, Wis.

D. C. So.—**David Churchill Somervell.** Assistant Master at Tonbridge School, Tonbridge, Kent, 1919– . Author of *The Reign of King George the Fifth, The British Empire;* etc

D. C. To.—**Rev. Duncan Crookes Tovey.** Former Assistant Master, Eton College. Editor of *The Letters of Thomas Gray;* etc.

D. C. T. T.—**David Christopher Traherne Thomas.** Assistant Lecturer, Courtauld Institute of Art, University of London. Author of *Cézanne; Turner.* Joint compiler, *The First Hundred Years of the Royal Academy 1769–1868* (catalogue of Royal Academy winter exhibition, London, 1951–52) and *Dutch Pictures 1450–1750* (R.A., 1952–53).

D. C. W.—**David Cleveland Wimer.** Professor of Soil Physics, University of Illinois, Urbana, Ill.

D. D. B.—**Donald D. Brand.** Professor and Chairman of the Department of Geography, University of Texas, Austin, Tex. Author of *Quiroga, a Mexican Municipio.*

D. D. C.-T.—**Dorothy Daisy Cottington-Taylor.** Director, Good Housekeeping Institute, 1924–40. Former Associate Editor, *Homes and Gardens.*

D. D. L.—**Don Divance Lescohier.** Professor of Economics, University of Wisconsin, Madison, Wis., 1918– . Author of *The Labor Market;* Co-author of *Population Problems; Can Business Prevent Unemployment?;* etc.

D. D. P.—**David D. Pratt.** Assistant Director, Chemical Research Laboratory, Teddington, Middlesex, Eng.

D. D. W.—**David Duncan Wallace.** Former Professor of History and Economics, Wofford College, Spartanburg, S.C. Author of *Life of Henry Laurens;* etc.

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D. E. C.—**Donald E. Cassels, M.D.** Associate Professor of Pediatrics, The University of Chicago Medical School, Chicago, Ill.

D. E. H.—**Rev. Dom. E. Horne.** Downside Abbey, Bath.

D. E. M.—**Donald E. McCown.** Associate Professor of Archaeology, the Oriental Institute, The University of Chicago. Field Director, Joint Expedition to Nippur. Author of *Comparative Stratigraphy of Early Iran;* co-author of *Tall-I-Bakhn A, Season of 1932.*

D. E. M. G.—**Dorothy Ellen Marion Gardner.** University Reader in Child Development and Head of the Department of Child Development, Institute of Education, University of London. Author of *The Children's Play Centre; Education Under Eight; Testing Results in the Infant School.*

D. E. S.—**David Eugene Smith.** Former Professor of Mathematics, Teachers College, Columbia University. Author of *History of Modern Mathematics;* etc.

D. E. Sp.—**Domina Eberle Spencer.** Assistant Professor of Physics, Brown University, Providence, R.I.

D. E. Wd.—**David E. Wiegand.** Senior Physicist, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

D. F. B.—**Donald F. Bond.** Professor of English, The University of Chicago. Co-editor of *A Critical Bibliography of French Literature,* vol. iv, *The Eighteenth Century.*

D. F. L.—**Daniel F. Lynch.** Former Director, Southern Research Laboratory, U.S. Department of Agriculture, New Orleans, La.

D. F. T.—**Sir Donald Francis Tovey.** Reid Professor of Music, University of Edinburgh, Scot., 1914–40. Author of *Essays in Musical Analysis* comprising the *Classical Concerto; The Goldberg Variations.*

D. F. Tr.—**Donald F. Taylor.** Chief Chemist, Farsteel Metallurgical Corporation, North Chicago, Ill.

D. G.—**Denis Rolleston Gwynn.** Research Professor of Modern Irish History, University College, Cork, Ire. Author of *Daniel O'Connell; History of Partition; Life of John Redmond;* etc.

D. Ga.—**Daniel Garber.** Painter, Member of Faculty, Pennsylvania Academy of Fine Arts, Philadelphia, Pa., 1909– .

D. Gd.—**Dorothy Good.** Member of the staff of the American Geographical Society, New York, N.Y. Co-author of *Japan: A Geographical View.*

D. Ge.—**David (William) Greene.** Assistant Professor, School of Celtic Studies, Dublin Institute for Advanced Studies, Dublin, Ire. Member of the Royal Irish Academy.

D. G. H.—**David George Hogarth.** Former Keeper of the Ashmolean Museum, Oxford, President of the Royal Geographic Society, 1925–27. Excavated at Paphos, 1888; Naucratis, 1889 and 1903; Ephesus, 1904–05; Asyut, 1906–07. Author of *The Nearer East; The Ancient East;* etc

D. Gi.—**Sir David Gill.** H.M. Astronomer at the Cape of Good Hope, 1879–1907.

D. G. K.—**Dattatreya Gopal Karve.** Executive Editor, *Bombay District Gazeteers* (revision). Author of *Federations; Population Problem in India.*

D. Gry.—**Dorothy Grafly.** Curator of collections, Drexel Institute, Philadelphia, Pa., 1934–45. Author of *Parade of American Art* series.

D. G. Z.—**Donald Guyer Zink.** Superintendent, Chemical Products Department, Stanolind Oil and Gas Company, Tulsa, Okla.

D. H.—**David Hannay.** Former British Vice-Consul at Barcelona. Author of *Short History of Royal Navy, 1217–1688;* etc.

D. H. A.—**Donald Hatch Andrews.** Professor of Chemistry and Director, Cyrogeny Laboratory, The Jonns Hopkins University, Baltimore, Md.

D. He.—**Dudley Heath.** Author of *Miniatures; Tradition and Modern Schools;* etc.

D. H. L.—**Dickson H. Leavens.** Former Research Associate, Cowles Commission for Research in Economics, The University of Chicago. Author of *Silver Money.*

D. H. Lr.—**Derrick Henry Lehmer.** Associate Professor of Mathematics, University of California, Berkeley, Calif.

Dh. M.—**Sir Dhiren Mitra.** Legal Adviser and Minister, India House, London.

D. H. M.—**Donald Howard Menzel.** Professor of Astrophysics, Harvard University. Author of *A Study of the Solar Chromosphere; Stars and Planets;* etc.

D. H. P.—**David Henry Peacock.** Former Professor of Chemistry, University of Rangoon, Rangoon, Burma. Author of *Life of Joseph Priestley.*

D. H. Pe.—**Douglas Henry Pike.** Reader in History, University of Adelaide, Adelaide, Austr.

D. Hr.—**Davenport Hooker.** Professor of Anatomy and Head of Anatomy Department, School of Medicine, University of Pittsburgh, Pittsburgh, Pa. Managing Editor, *Journal of Comparative Neurology.*

D. H. R.—**Dennis Holme Robertson.** Professor of Political Economy, Cambridge University, 1944– . Author of *Money* in Cambridge Economic Handbook series.

D. H. S. C.—**Very Rev. David Herbert Somerset Cranage.** Dean of Norwich, Eng., 1928–45.

D. Hu.—**Dard Hunter.** Author of *Primitive Papermaking; Old Papermaking;* etc.

D. I. C.—**Denis Irvine Coomber.** Senior Scientific Officer, Department of the Government Chemist, London

D. J.—**Diamond Jenness.** Former Chief, Division of Anthropology, National Museum of Canada, Ottawa, Ont. Author of *The Indians of Canada; The People of the Twilight;* etc.

D. Ja.—**Dunham Jackson.** Professor of Mathematics, University of Minnesota, Minneapolis, Minn., 1919–46. Author of *Fourier Series and Orthogonal Polynomials;* etc.

D. J. D.—**Delbert J. Duncan.** Professor of Marketing, University of California, Berkeley, Calif. Co-author of *Marketing: Principles and Methods; Retailing: Principles and Methods.*

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D. J. K.—**Duncan J. Kerr.** Former President, Lehigh Valley Railroad, New York, N.Y.

D. J. M.—**D. J. Matthews.** Formerly with Hydrographic Department, Admiralty, London. Former Hydrographer, Laboratory of the Marine Biological Association of the United Kingdom, Plymouth.

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D. Ka.—**Daniel Katz.** Professor and Chairman of the Department of Psychology, Brooklyn College, Brooklyn, N.Y.

D. Kg.—**Donald King.** Assistant Keeper, Victoria and Albert Museum, London.

D. Kn.—**Dorothy Kenyon.** Member, League of Nations Committee on Legal Status of Women, 1938–43.

D. K.-P.—**Douglas King-Page.** Author of *Marine Insurance in 1931.*

D. K. Pe.—**Don K. Price.** Associate Director of Public Administration Clearing House, Chicago, Ill. Co-author of *City Manager Government in the United States.*

D. L.—**David Lyell.** Colonel. Former Director of Pauling and Company, Ltd., London. Chief Railway Construction Engineer to the British Army in France during World War I.

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D. L. Hk.—**Dalziel Llewellyn Hammick.** Fellow and Tutor, Oriel College Oxford. Aldrichian Praelector in Chemistry, Oxford University Author of *Introduction to Organic Chemistry.*

D. L. Mu.—**David Leslie Murray.** Editor, *Times* Literary Supplement, London, 1938–44. Author of *Disraeli.*

D. L. R. L.—**David Lockhart Robertson Lorimer.** Lieutenant Colonel, Indian Army (retired). Former H.M. Consul, Kerman and Persian Baluchistan; Civil Governor, Amāra, 1915–16. Author of *Phonology of the Bakhtiari Badakhshani and Madaglashti Dialects of Modern Persian;* etc.

D. L. W.—**D. L. Walker.** General Secretary to the Federation of British Industries.

D. L. Wr.—**David L. Webster.** Professor of Physics, Stanford University, Stanford, Calif. Co-author of *General Physics for Colleges.*

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D. M.—**Rev. Dugald Macfadyen.** Former Director of the London Missionary Society.

D. Ma.—**David Masson.** Former Historiographer Royal for Scotland. Professor of Rhetoric and English Literature, Edinburgh University, 1865–93. Author of *Life of Milton;* etc.

D. M. B.—**Dorothy M. Broome.** Former Jones Fellow in the Victoria University of Manchester, England.

D. M. Bl.—**Delbert M. Bergenstal, M.D.** Assistant Professor of Medicine, The University of Chicago Medical School, Chicago, Ill.

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D. Md.—**Duncan MacDougald, Jr.** Author of *The Languages and Press of Africa.*

D. Me.—**Sir David Milne.** Permanent Undersecretary of State for Scotland, Edinburgh, Scot.

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D. Mi.—**David Mitrany.** Professor in School of Economics and Politics, Institute for Advanced Study, Princeton, N J, 1933– . Author of *Marx against the Peasant; The Progress of International Government; The Effect of the War in Southeastern Europe; A Working Peace System;* etc.

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D. M. S.—**Doris Mary Stenton.** Lecturer in History in the University of Reading, England. Author of *The Reign of Henry II; The Earliest Lincolnshire Anise Rolls;* etc.

D. M. Se.—**Dorothy M. Sells.** Former special agent of the U.S. Department of Labor, and Assistant Professor of Social Economy, Bryn Mawr College Bryn Mawr, Pa. Author of *British Trade Boards System.*

D. M. Sh.—**Denis Mack Smith.** Fellow and Tutor of Peterhouse, Cambridge University.

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D. M. W.—**Sir Donald Mackenzie Wallace.** Director of the Foreign Department of *The Times,* 1891–99. Author of *Russia.*

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D. S. K.—**Dexter Simpson Kimball.** Former Dean, College of Engineering, Cornell University, Ithaca, N.Y. Author of *Industrial Education;* etc. Editor, *The Book of Popular Science.*

D. S. M.—**Prince Dimitri Mirsky.** Lecturer in Russian Literature, King's College, University of London, 1922–32. Author of *Contemporary Russian Literature; Pushkin; History of Russian Literature,* etc.

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D. T.—**Deems Taylor.** Author, radio and television commentator, composer, New York, N.Y. Author of *Music to My Ears, Of Men and Music; The Well-Tempered Listener.*

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D. V. B.—**Dow Vawter Baxter.** Professor of Forest Pathology, University of Michigan, Ann Arbor, Mich. Author of *Pathology in Forest Practice;* etc.

D. W.—**Diedrich Hermann Westermann.** Professor of African Languages in the University of Berlin, 1920– . Co-author of *Practical Phonetics for Students of African Languages;* etc.

D. Wh.—**Derwent Whittlesey.** Professor of Geography, Harvard University. Author of *The Earth and the State; A Study of Political Geography;* etc. Editor, *Annals of the Association of American Geographers,* 1930–42.

**D. W. K.—Dudley Wright Knox.** Commodore, U.S. Navy (ret.). Author of *A History of the United States Navy; The Eclipse of American Sea Power; The Naval Genius of George Washington*, etc.

**D. W. Ku.—Rev. Daniel Webster Kurtz, D.D.** Clergyman, educator and author President of General Education Board, Church of the Brethren, 1915–35.

**D. W. T.—Sir D'Arcy Wentworth Thompson.** Professor of Natural History, University of St. Andrews, Scot., 1917–48.

**D. W. W.—Dilworth Wayne Woolley.** Associate of the Rockefeller Institute for Medical Research, New York, N.Y.

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**E. A. B.—Eric Arthur Barber.** Rector of Exeter College, Oxford.

**E. A. Ba.—Ernest A. Baker.** Director, University of London School of Librarianship, 1919–34; Author of *The Public Library; The Uses of Libraries;* etc.

**E. A. Bl.—Emery A. Brownell.** Executive Director, National Legal Aid Association. Author of *Legal Aid in the United States.*

**E. A. Br.—Edwin Arthur Baker.** Principal Scientific Officer, Royal Observatory, Edinburgh, Scot.

**E. A. D.—Edgar A. Doll.** Co-ordinator of Research, Devereux School, Devon, Pa. Author of *Clinical Studies in Feeble-mindedness.*

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**E. A. G.—Eugene Allen Gilmore.** Former Professor of Law; President, 1934–40, State University of Iowa, Iowa City, Ia.

**E. A. Gr.—Emanuel Alexander Goldenweiser.** Former member of the Institute for Advanced Study, Princeton, N.J. Director of Division of Research and Statistics, Board of Governors of the Federal Reserve System, 1926–45. Author of *Federal Reserve System in Operation.*

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**E. A. J.—E. Alfred Jones.** Author of *Old English Gold Plate; Old Church Plate of the Isle of Man;* etc.

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**E. A. Mi.—Edward Arthur Milne.** Rouse Ball Professor of Mathematics and Fellow of Wadham College, Oxford, 1928–50. Author of *Thermodynamics of the Stars;* etc.

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**E. Ap.—Erik Arup.** Former Professor of Danish History at the University of Copenhagen, Denmark.

**E. A. P.—Edgar Allison Peers.** Former Gilmour Professor of Spanish, University of Liverpool, Liverpool, Eng Author of *Spain, A Companion to Spanish Travel; Studies of the Spanish Mystics;* etc.

**E. A. Pr.—E. A. Power.** Chief, Statistical Section, Branch of Commercial Fisheries, Fish and Wildlife Service, U S Department of the Interior, Washington, D C Author of *Fishery Statistics of the United States.*

**E. A. Ps.—Edward Alexander Parsons.** President, Louisiana Historical Society. Author of *The Letters of Robert R Livingston—The Diplomatic Story of The Louisiana Purchase;* etc.

**E. Ar.—Edward Armstrong.** University Lecturer in Modern History, Oxford University. Author of *The Emperor Charles V;* etc.

**E. A. R.—Rev. Edward A. Ryan, S.J.** Archivist, Woodstock College, Woodstock, Md Author of *The Historical Scholarship of St. Bellarmine.*

**Ea. S.—Ezra Solomon.** Assistant Professor of Finance, The University of Chicago. Editor of *Journal of Business.*

**E. A. S.—Rev. E. A. Shattock.** Vicar of St. Mark, Woodcote, Purley, England.

**E. A. Sp.—Elmer A. Sperry.** Founder of the Sperry Gyroscope Company.

**E. At.—Edith Abbott.** Professor and Emeritus Dean of the School of Social Service Administration, The University of Chicago. Author of *Public Assistance: American Principles and Policies; The Tenements of Chicago.*

**Ea. T.—Earl Theisen.** Honorary Curator Motion Pictures and Theatric Arts, Los Angeles Museum, Los Angeles, Calif.

**E. B.—Sir Ernest Barker.** Life Governor of King's College, University of London. Author of *Greek Political Theory; Essays on Government;* etc.

**E. B. B.—Sir Edward Battersby Bailey.** Director of Geological Survey of Great Britain and Museum of Practical Geology, 1937–45. Author of *Recumbent Folds in the Schists of the Scottish Highlands;* etc.

**E. B. By.—Emmet Blackburn Bay, M.D.** Professor of Medicine, The University of Chicago, Chicago, Ill. Author of *Medical Administration of Teaching Hospitals.*

**E. B. C.—Edwin Beresford Chancellor.** Former member of the Council of London Topographical Society. Author of *The London of Charles Dickens; The Clubs of London, Past and Present.*

**E. B. Cl.—Eric Bertrand Ceadel.** University Lecturer in Japanese, Cambridge University Author of *Literature* [illegible]

**E. Be.—Eduard Beneš.** President of the Czechoslovak Republic, 1935–38 and 1946–48. Author of *Bases of Europe; Problems of Czechoslovakia;* etc

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**E. Bg.—Eskil Berg.** Formerly of General Electric Company, Schenectady, N.Y.

**E. B. H.—E. B. Hudson.** Senior General Engineer, American Rolling Mill Company, Middletown, O.

**E. B. He.—Edward Butler Hodge.** Research Chemist, Commercial Solvents Corp., Terre Haute, Ind.

**E. B. Hg.—Emanuel Benjamin Hershberg.** Research Chemist, Schering Corporation, Bloomfield, N.J.

**E. B. Hy.—Ethel Browne Harvey.** Independent Investigator, Department of Biology, Princeton University.

**E. Bn.—Eduard Bernstein.** Editor, with August Bebel, of *Sozialdemokrat.* Author of *Die Voraussetzungen des Sozialismus und die Aufgaben der Sozialdemokratie;* etc.

**E. B. N.—Evan Baillie Noel.** Former Secretary of Queen's Club, London.

**E. B. O.—E. B. Osborn.** Former Literary Editor of the *Morning Post,* London Author of *The New Elizabethans; Our Debt to Greece and Rome; The Middle Ages; Socrates and His Friends;* etc.

**E. B. Po.—Sir Edward Bagnall Poulton.** Hope Professor of Zoology in Oxford University, 1893–1933. Author of *The Colours of Animals; Essays on Evolution;* etc.

**E. Br.—Edward Breck.** Former Foreign Correspondent of *The New York Herald* and *The New York Times.* Executive, History Section, U.S. Navy Department, 1919–22. Author of *Sporting Guide;* etc.

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**E. B. Sa.—Eleanor B. Sachs.** Former Assistant Curator, Metropolitan Museum of Art, New York, N.Y.

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**E. B. V. V.—E. Burr Van Vleck.** Former Professor of Mathematics, University of Wisconsin, Madison, Wis. Editor of *Transactions of the American Mathematical Society.*

**E. B. Wn.—Edwin Brayton Wilson.** Executive Editor of the *Brooklyn Daily Eagle,* Brooklyn, N.Y.

**E. Bz.—Eiríkur Benedikz.** First Secretary, Icelandic Legation, London. Author of *Ensk Verzlunarbréf; Enska I-II.*

**E. C.—Edward Channing.** Former Professor of History, Harvard University. Author of *History of the United States; Town and Country Government in English Colonies of North America;* etc.

**E. Ca.—Emile Cammaerts.** Former Professor of Belgian Studies and Institutions in the University of London Author of *Belgium, From the Roman Invasion to the Present Day; New Belgian Poems; Albert of Belgium;* etc

**E. Cas.—Egerton Castle.** Formerly of Trinity College, Cambridge Author of *English Book Plates, Bibliotheca Dimicatoria;* etc.

**E. C. B.—Rt. Rev. Edward Cuthbert Butler.** Abbot of Downside Abbey, Bath, England, 1906–22.

**E. C. Bn.—Edmund Charles Blunden.** Author of *Undertones of War; Shelley: A Life-Story; Shells by a Stream; After the Bombing.*

**E. C. Br.—Edward C. Bridgman.** President, Bridgman Publishers, Inc., Pelham, N.Y.

**E. C. Bu.—Eric C. Burkman.** Secretary, United States Rubber Company, New York, N Y.

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**E. C. F.—Ernest Carroll Faust.** Professor of Parasitology, Head of Division, Department of Tropical Medicine and Public Health, Tulane University of Louisiana, New Orleans, La. Author of *Human Helminthology; Clinical Parasitology.*

**E. C. G.—Egerton C. Grey.** Former Professor of Chemistry University of Cairo. Author of *Practical Chemistry by Micromethods;* etc.

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**E. C. Kg.—Edward C. King.** Dean and Professor of Law, School of Law, University of Colorado, Boulder, Colo. Author of *Future Interests in Colorado.*

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**E. C. L.—E. C. Laidlay.** Subeditor of *The Fur World,* London.

**E. Cn.—Emil Carlsen.** Former member of National Academy of Design and of Institute of Art and Letters.

**E. C. of D.—Ellen Odette Desart, Countess Dowager of Desart.** Former Senator, Irish Free State. Author of *A Guide for Secretaries, Public and Private; Style and Title* (with Constance Hoster).

**E. C. Q.—Edmund Crosby Quiggin.** Former Fellow of, and Lecturer in, Modern Languages and Monro Lecturer in Celtic, Gonville and Caius College, Cambridge.

**E. Cr.—Ernst Cassirer.** Former Professor of Philosophy and Rector of Hamburg University, Hamburg, Ger. Author of *Kants Leben und Lehre; Substanzbegriff und Funktionsbegriff;* etc.

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**E. C. Sd.—Edwin Colston Shepherd.** Secretary-General, Air League of the British Empire. Author of *Great Flights; The R.A.F. Today.*

**E. C. Ss.—E. C. Simmons.** Associate Professor of Economics, Duke University, Durham, N C.

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**E. Cul.—Ely Culbertson.** Author of *Contract Bridge Red Book on Play; Contract Bridge Blue Book;* etc. Editor, *The Bridge World Magazine*

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**E. de W.—Ernest De Weerth.** Stage designer, Max Reinhardt Productions in America, etc.

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**Ed. M.—Eduard Meyer.** Former Professor of Ancient History in the University of Berlin. Author of *Geschichte des Altertums;* etc.

**E. D. M.—Edward Darley Miller.** Lieutenant Colonel. Author of *Modern Polo;* etc.

**E. D. Macl.—Sir Edward Douglas MacLagan.** Governor of the Punjab, 1921–24. Lieutenant Governor, 1919–21. Former President of Royal Asiatic Society.

**E. D. Ml.—Elmer Drew Merrill.** Arnold Professor of Botany; former Administrator of Botanical collections and Director of Arnold Arboretum, Harvard University. Author of *Plantae Elmerianae Borneenses; Discussion and Bibliography of Philippine Flowering Plants;* etc.

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**E. D. R.—Sir Edward Denison Ross.** Director, School of Oriental Studies, London, and Professor of Persian in the University of London, 1916–37. Author of *Eastern Art and Literature; The Persians;* etc.

**E. D.-Ra.—Emilius C. Delme-Radcliffe.** Lieutenant Colonel. Author of *Falconry: Notes on the Falconidae used in India in Falconry.*

**E. D. T. J.—Evan David Thomas Jenkins.** Professor of Classics, University College of Wales, Aberystwyth, 1938–47.

**E. D. Ts.—Elbert Duncan Thomas.** Senator from Utah, 1933–51. Professor of Political Science, University of Utah, Salt Lake City, 1924–33.

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**E. E. F.—Edward Elway Free.** Consulting chemist and physicist. Lecturer on Outlines of Science, New York University, 1926–34. Author of *Pocket Guide to Science.*

**E. E. H.—Edward Everett Hale.** American writer. Author of *The Man Without a Country.*

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**E. E. K.—Edward Ernest Kellett.** Former literary critic and author. Former Senior English Master, the Leys School, Cambridge, Eng. Author of *Suggestions; Fashion in Literature; The Northern Saga;* etc.

**E. E. L.—Edward Ernest Long.** British journalist.

**E. En.—Edward Epstean.** Former Treasurer and Director, Walker Engraving Corporation, New York, N.Y.

**E. E. R.—Edgar Eugene Robinson.** Director, Institute of American History, and Executive Head, Department of History, Stanford University, Stanford, Calif. Author of *The Presidential Vote; The New United States; The Evolution of American Political Parties.*

**E. E. S.—Edward Ernest Sikes.** Former Fellow, President and Lecturer, St. John's College, Cambridge. Newton Student at Athens, 1890. Editor of Aeschylus' *Prometheus Vinctus,* 1898; *The Homeric Hymns,* 1904. Author of *Anthropology of the Greeks;* etc.

**E. E. Sh.—Eben E. Smith, M.D.** Captain, Medical Corps, U.S. Navy, 1941– . Editor, *U.S. Naval Medical Bulletin;* Instructor in History of Medicine, U S. Naval Medical School, Washington, D.C.

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**E. E. Sm.—Ernest Ellsworth Smith, M.D.** Former specialist in Experimental Medicine and Chemical Warfare.

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**F. Boo.—Franklin Booth.** Illustrator, painter.

**F. Bra.—Frederick [illegible] Freeman** of the Company of Cu[illegible], England. Author of *History of Old Sheffield Plate;* etc.

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**F. J. Mn.—Frederick Justin Mann.** Organization and Methods Examiner, Bureau of Security and Consular Affairs, U S Department of State, Washington, D C. Co-author of *Creation of Rights of Sovereignty Through Symbolic Acts 1400–1800.*

**F. J. N.—Frederick J. North.** Keeper of the Department of Geology, National Museum of Wales Cardiff

**F. J. O.—Frances Jenkins Olcott.** Organizer and former Director of Training School for Children's Librarians, Carnegie Library, Pittsburgh, Pa. Author of *The Children's Reading;* etc.

**F. J. P.—F. J Pettijohn.** Professor of Geology, The Johns Hopkins University, Baltimore, Md. Author of *Sedimentary Rocks.*

**F. J. S.—Frederick J. Stevenson.** Geneticist, Bureau of Plant Industry, Soils, and Agricultural Engineering, U S. Department of Agriculture.

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**F. J. T.—Frederick Jackson Turner.** Former Professor of History, Harvard University. Author of *Rise of the New West;* etc.

**F. J. W.—Frank John Wilson.** Chief, U S. Secret Service, Treasury Department. Washington, D C, 1936–46.

**F. K.—Friedrich Wilhelm Eduard Keutgen.** Former Professor of History, University of Hamburg, Ger. Author of *Die Hanse und England im 14 Jahrhundert;* etc.

**F. K. B.—Frederic K. Brown.** Author of *The Playtime Guide Book;* etc.

F. Ke.—Florence Kelley. Formr Secretary, U S Board of Control of Labor Standards for Army Clothing. Author of *Modern Industry*

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F. L. Kg.—Frank L. King. Executive Secretary, Fountain Pen and Mechanical Pencil Manufacturers' Association.

F. L. L.—Lady Lugard (Flora). Former Head of Colonial Department of *The Times*, London. Author of *A Tropical Dependency.*

F. Ll. G.—Francis Llewellyn Griffith. Former Professor and Reader in Egyptology, Oxford University. Former Editor of the *Archaeological Survey* and *Archaeological Reports* of the Egypt Exploration Fund Author of *The Nubian Texts of the Christian Period;* etc.

F. L. Mt.—Frank Luther Mott. Dean, School of Journalism, University of Missouri, Columbia, Mo Author of *American Journalism.*

F. L. P.—Frederic Logan Paxson. Former Margaret Byrne Professor of History, Univ. of California Author of *History of the American Frontier;* etc.

F. Lr.—Friedrich Lemmer. Economic Correspondent in Bonn, Ger., of the *Basler Nachrichten.*

F. L. S.—Frederick Lewis Schuman. Woodrow Wilson Professor of Government, Williams College, Williamstown, Mass. Author of *Germany since 1918; The Nazi Dictatorship;* etc. Co-author of *Design for Power.*

F. L. We.—Fred Lawrence Whipple. Associate Professor, Harvard University. Author of *Earth, Moon and Planets*

F. M.—Sir Francis Meynell. Author of *The Typography of Newspaper Advertisements.*

F. Mac.—Fitzroy Maclean. Member of Parliament for Lancaster, Eng.

F. M. Bu.—Frank Macfarlane Burnet, M.D. Director Walter and Eliza Hall Institute of Medical Research, Melbourne, Austr Research Professor in Experimental Medicine University of Melbourne, Melbourne, Austr Author of *Biological Aspects of Infectious Disease, Natural Organism*

F. M. C.—Frederick M. ("Fog Horn") Clancy. Author of *The Rodeo Up, Stampede and Cowboy Sports Guide*

F. M. Cr.—F. M. Carpenter. Professor of Entomology Agassiz Professor of Zoology and Curator of Fossil Insects, Museum of Comparative Zoology Harvard University.

F. M. Du.—F. Martin Duncan. Former Librarian of the Zoological Society of London.

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F. M. Kg.—Felix M. Keesing, Professor and Executive Head of the Department of Sociology and Anthropology Stanford University, Stanford, Calif Author of *Native Peoples of the Pacific World; The South Seas in the Modern World*, etc.

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F. Mn.—Frank Morgan. Actor, stage and motion pictures

F. Mo.—Frances Morris. Associate Curator, Department of Decorative Art, Metropolitan Museum of Art, New York, N Y Vice-President of the Needle and Bobbin Club

F. M. P.—Sir Frederick Maurice Powicke. Regius Professor of Modern History, Oxford University, 1928–47 Honorary Fellow of Merton College, Oxford and of Balliol College Author of *The Loss of Normandy; Stephen Langton*, etc

F. M. Rn.—Francis Minot Rackemann, M.D. Physician Massachusetts General Hospital, Boston, Mass Author of *Clinical Allergy Particularly Hay Fever and Asthma*

F. M. S.—Sir Frank Merry Stenton. Former Professor of Modern History and Vice-Chancellor, University of Reading Reading, Eng Author of *The Danes in England;* etc

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F. M. T. B.—F. M. T. Bohl, D.D. Rector of the University of Groningen, 1924–25

F. Mu.—Frank Murphy. Former Associate Justice, U.S. Supreme Court

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F. Na.—Fridtjof Nansen. Arctic explorer. Former Professor of Oceanography, Oslo University. Minister for Norway at the Court of St James's, 1906–08 Nobel Peace Prize. 1921–22. Author of *Armenia and the Near-East.*

F. N. F.—Frank Nugent Freeman. Professor of Educational Psychology and Dean, School of Education, University of California, Berkeley, Calif Author of *Visual Education;* etc.

F. N. H.—Frank Norman Howes, Keeper, Museums of Economic Botany, Royal Botanic Gardens, Kew, Eng Author of *Nuts, Plants and Products Yielding Vegetable Gums and Resins, Vegetable Tanning Materials.*

F. N. M.—Frederic Natusch Maude Colonel Author of *Cavalry, Its Past and Future, Evolution of Strategy* (translated into German), *War and the World's Later Campaign of Leipzig;* etc.

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F. O. W.—F. O. Waage. Professor of the History of Art and Archaeology and Chairman of the Dept. of Fine Arts, Cornell University, Ithaca, N Y Author of *Excavations at Antioch-on-the-Orontes,* vol. iv, part 1

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F. Po.—Rt. Hon. Sir Frederick Pollock. Former Judge of Admiralty Court of Cinque Ports, Editor of *Law Reports*, 1895–1935; Corpus Professor of Jurisprudence, Oxford University, 1883–1903 Author of *Principles of Contract;* etc.

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F. R.—Francis Rawle. Editor of Revisions of *Bouvier's Law Dictionary* 1883, 1898, 1913; etc.

F. Ra.—Frank Rabak. Consultant and Biochemist. S S Steiner, Inc., New York, N Y Associate biochemist, U S. Department of Agriculture, 1927–46.

Fr. Br.—Fritz Brugel. Director of the Research Institute of Social Problems, Vienna.

F. R. C.—Frank Richardson Cana. Author of *Scott Africa from the Point of View of the Union*, etc.

F. R. H.—Frederic Robert Harris. Consulting Engineer, New York, N Y

F. R. H.-J.—F. R. Harlestone-Jones. Former Joint Secretary of the Incorporated Association of Head Masters Headmaster of Holloway School

F. R. L.—Frank R. Lillie. Former Andrew MacLeish Distinguished Service Professor of Embryology, The University of Chicago. Author, *The Development of the Chick;* etc.

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F. R. T.—Frederick Robert Tennant, D.D. Lecturer in Theology, 1913–31, and Fellow of Trinity College, Cambridge Author of *Philosophical Theology;* etc.

F. R. W.—Floyd Rowe Watson. Emeritus Professor of Physics, University of Illinois, Urbana, Ill. Editor of *The Acoustical Journal,* 1929–39.

F. S.—Francis Storr. Former Editor of *The Journal of Education,* London.

F. S. B.—Frederick S. Boas. Inspector of English Language and Literature to the London County Council, 1905–27. Author of *Shakespeare and His Predecessors; University Drama in the Tudor Age;* etc.

F. Sc.—F. Scholefield. Lecturer in Bleaching, Dyeing, Printing and Finishing in the Manchester Municipal College of Technology, Manchester, England.

F. S. E.—Frederick Seward Erdman. Associate Professor of Mechanical Engineering, Cornell University, Ithaca, N Y.

F. S. G. F.—Francis Stewart Gilderoy Piggott. Major General, formerly with British Army Author of *Broken Thread; The Elements of Sosho.*

F. Sh.—Frederick William Sherwood. Barrister-at-Law, former Recorder of Worcester.

F. S. H.—Frank Stewart Howes. Music Critic, *The Times.* Lecturer, Royal College of Music, London Author of *The Borderland of Music and Psychology, Byrd, Full Orchestra; Man, Mind and Music; The Music of Vaughan Williams.*

F. Si.—F. Simon. Counsellor of the Foreign Office, Berlin Former Private Secretary to Herr Rathenau.

F. S. M.—Rev. Fred Shipley Marsh. Lady Margaret's Professor of Divinity, Cambridge University, 1935–51.

F. S. N.—Frederick Samuel Northedge. Lecturer in International Relations, London School of Economics and Political Science, University of London.

F. S. P.—Francis Samuel Philbrick. Professor of Law, University of Pennsylvania, Philadelphia, Pa, 1929–47. Translator of Hübner's *History of Germanic Private Law.*

F. Ss.—Frank Smithies. Lecturer in Mathematics, Cambridge University.

F. Sz.—Frederick Seitz. Professor of Physics, Department Head, Carnegie Institute of Technology, Pittsburgh, Pa. Author of *Modern Theory of Solids; The Physics of Metals.*

F. T.—Frank Twyman. Honorary Associate, Manchester Municipal College of Technology, Manchester, Eng. Author of *Prism and Lens Making,* etc.

F. T. H.—Francis Temple Grey Former Assistant Secretary of the International Law Association

F. T. H. A.—Sir F. T. A. Hobday. Former Honorary Veterinary Surgeon to the King, Principal and Dean, Royal Veterinary College. Author of *Cattle and Cattle Surgery;* etc

F. T. H.—F. T. Harvey. Examiner in Veterinary Medicine to the Royal College of Veterinary Surgeons

F. T. J.—Frederic Theodore Jung, M.D. Assistant Secretary, Council on Physical Medicine, American Medical Association.

F. T. M.—Sir Frank T. Marzials. Editor of "Great Writers" Series.

F. T. W.—Frederick T. Weber. Portrait painter, sculptor and etcher.

F. v. H.—Baron F. von Hügel. Author of *The Mystical Element of Religion;* etc.

F. V. S.—Frazer V. Sinclair. President, Drug and Cosmetic Industry, New York, N Y

F. V. W.—Sir Francis Verner Wylie. Indian civil servant (retired).

F. Wa.—Sir Frank Warner. Chairman of Silk Advisory Committee, Imperial Institute, 1917–27 President of the Textile Institute, 1918–20 Chairman of British Silk Research Association, 1920–27. Author of *The Silk Industry of the United Kingdom*

F. W. A.—Francis William Aston. Nobel Prize for Chemistry, 1922 Author of *Isotopes;* etc.

F. W. B.—Frederick William Bradnock. Public Relations Officer, Birmingham Eng Editor of *City of Birmingham Official Handbook.*

F. W. D.—Frederic William Drew. Author and journalist Studied for thirty-five years viniculture and the cultivation and marketing of tropical and subtropical produce.

F. W. F.—Frank Whitson Fetter. Professor of Economics, Northwestern University, Evanston, Ill.

F. Wg.—Fredrik Wulfsberg. Cultural Attache, Norwegian Embassy, London.

F. W. G.—Sir Frank W. Goldstone. General Secretary of the National Union of Teachers, 1924–31

F. W. H.—Frederick Webb Hodge. Director, Southwest Museum, Los Angeles, Calif Ethnologist with Museum of American Indian, Heye Foundation, New York, N.Y., 1918–31.

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F. W. J.—Frank William Johnson. Writer and lecturer on botanical subjects

F. W. Js.—Frederic Wood Jones. Honorary Curator, the Royal College of Surgeons, London. Author of *Hallmarks of Mankind; The Mammals of South Australia; Man's Place Among the Mammals;* etc.

F. W. M.—Frederic William Maitland. Former Downing Professor, Cambridge University. Author of *History of English Law* (with Sir F. Pollock); *English Law and the Renaissance;* etc.

F. W. McB.—F. Webster McBryde. Geographer-Consultant, Bureau of the Census, U S Department of Commerce, and Institute of Inter-American Affairs. Lecturer-Professor, Department of Geography, University of Maryland, College Park, Prince George's County and Baltimore, Md. Author of *Cultural and Historical Geography of Southwest Guatemala, Sololá: A Guatemalan Town and Cakchiquel Market-Center.*

F. W. Mc.—Sir Frederick Walker Mott, K.B.E., M.D. Former Consulting Physician to Charing Cross Hospital, London Former Pathologist to London County Asylums and Lecturer on Morbid Psychology, Birmingham University Author of *War Neuroses and Shell Shock;* etc.

F. W. O.—Francis Wall Oliver. Quain Professor of Botany, University College, University of London, 1888–1929. Former Editor of *Annals of Botany.*

F. W. P.—Frank W. Peek, Jr. Former Engineer in Charge, General Transformer Engineering Department and High Voltage Engineering Laboratory, General Electric Company, Pittsfield, Mass. Author of *Dielectric Phenomena in High Voltage Engineering*

F. W. Q.—Frances Wells Quantius. Assistant Professor of Economics, Ohio State University, Columbus, O Co-author of *Economics. Basic Problems and Analysis.*

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F. W. R.—Frederick William Rudler. Curator and Librarian of the Museum of Practical Geology, London, 1879–1902.

F. W. R. B.—F. W. Rogers Brambell. Professor of Zoology, University of Wales, University College of North Wales, Bangor, Wales Author of *The Development of Sex in Vertebrates;* etc.

F. W. Re.—Frank Walton Roe. Director of the Geological Survey Department, British Territories in Borneo Author of *Memoirs* of the Geological Survey of the Federation of Malaya.

F. W. Sh.—Francis Wayland Shepardson. Former Editor of *Baird's Manual of American College Fraternities.*

F. Wt.—Francis Watt. Author of *Law's Lumber Room.*

F. W. T.—Frank William Taussig. Professor of Economics, Harvard University, 1901–35 Author of *Principles of Economics; Tariff History of the United States;* etc.

F. W. Ta.—Fred Wilbur Tanner. Professor of Bacteriology, also Head of the Department of Bacteriology, University of Illinois, Urbana, Ill. Author of *Bacteriology and Mycology of Foods;* etc. Co-author of *The Yeasts*

F. W. Th.—Frederick William Thomas. Former Librarian to the India Office, London; Lecturer in Comparative Philology and Reader in Tibetan, University College, University of London Honorary Secretary, 1920–27, and Director, 1921–22, of Royal Asiatic Society Boden Professor of Sanskrit, Oxford University, 1927–37. Former Editor of *Epigraphia India.*

F. W. W.—Frederic W. Whyte. Author of *Actors of the Century;* etc. Translator of Filon's *English Stage;* etc.

F. W. We.—Frederick W. Weber. Treasurer and Director of F. Weber Company, Inc., Philadelphia, Pa.

F. W. W. G.—F. W. W. Gwynne. Major A Director of Lena Goldfields Limited, London

F. W. W.-S.—Francis William Wentworth-Sheilds. Artist. Visiting Instructor, Twickenham School of Art, Middlesex, Eng

F. X. T.—Rev. Francis Xavier Talbot, S.J. Former Editor in Chief of *America*, national Catholic weekly, New York, N Y Author of *Jesuit Education in Philadelphia;* etc

F. Y.—Sir Frederic William Young. Former Chief Surveyor, Liverpool Salvage Association Commodore, R N R, and Head of Admiralty Salvage Section, 1914–18

G.—Ronald Gorell Barnes, 3rd Baron Gorell. Honorary Fellow, Royal Society of Teachers Chairman, Teachers Registration Council, 1922–35.

G. Ab.—Grace Abbott. Former Professor, School of Social Service, The University of Chicago Former Chief of U S Children's Bureau, Washington, D C Author of *The Immigrant and the Community*

G. A. Bl.—Gilbert Ames Bliss. Former Professor and Chairman of the Department of Mathematics, The University of Chicago

G. A. Bo.—Giuseppe Antonio Borgese. Former Professor of Italian Literature, The University of Chicago Author of *History of Romantic Criticism;* etc

G. A. Bt.—George Allen Bennett, M.D. Associate Professor of Anatomy, Jefferson Medical College, Philadelphia, Pa.

G. A. Bu.—G. A. Burls. Author and Co-editor with Sir Dugald Clerk of works on internal combustion engines.

G. A. C.—Rev. George Albert Cooke, D.D. Regius Professor of Hebrew, Oxford University, and Canon of Christ Church, 1914–36 Oriel Professor of the Interpretation of Holy Scripture at Oxford University, 1908–14.

G. A. Cr.—G. Arthur Cooper. Curator of Invertebrate Palaeontology and Palaeobotany, United States National Museum, Washington, D C Co-author of *Brachiopod Genera of the Suborders Orthoidea and Pentameroidea,* etc.

G. Ad.—Gilbert Adrian. Dress designer. Costume designer for the Metro-Goldwyn-Mayer Studios.

G. A. E.—George Anderson Eastwood. President and Chairman of the Board, Armour and Company, Chicago.

G. A. H.—George Andrew Hawkins. Dean of Engineering and Director of Engineering Experiment Station, Purdue University, Lafayette, Ind Author of *Thermodynamics;* co-author of *Elements of Heat Transfer and Insulation*

G. A. H. S.—George A. H. Scott. General Counsel, Illinois Humane Society. Director, American Humane Association.

G. A. K.—George Arthur Kelly. Executive Vice-President of the Pullman Company, Chicago.

G. A. Mn.—George Ashmun Morton. Research Physicist, RCA Laboratories, Princeton, N J. Co-author of *Television;* etc.

G. An.—Gleb von Anrep. Professor of Physiology in the University of Cairo, Egypt.

G. A. P.—George A. Pfeiffer. Former Professor of Mathematics, Columbia University.

G. A. R. C.—Sir Geoffrey Arthur Romaine Callender. Former Director, National Maritime Museum, London. Honorary Secretary and Treasurer to the Society for Nautical Research Former Professor of History and English at the Royal Naval College, Greenwich, England. Author of *The Life of Nelson; The Naval Side of British History;* etc.

G. A. Rl.—George Armytage Rounsefell. Aquatic Biologist, Fish and Wildlife Service, U S Dept of the Interior

G. A. Ro.—Gar A. Roush. Metals Engineer, U S Treasury Department Bureau of Federal Supply, Strategic and Critical Material Division, 1946– Editor, *Mineral Industry*, New York, 1913–43 Mineral Technologist, U S Bureau of Mines, 1943–46. Author of *Strategic Mineral Supplies*

G. A. Sn.—Gustav A. Swanson. Professor and Head of the Department of Conservation, Cornell University, Ithaca, N.Y.

G. At.—Gertrude Franklin Atherton. Author of *Rezánov; Ancestors;* etc.

G. A. T.—George Alfred Thiel. Professor and Chairman of the Department of Geology and Mineralogy, University of Minnesota, Minneapolis, Minn. Author of *The Geology and Water Resources of Southern Minnesota, Geology, Principles and Processes; Limestones and Marls of Minnesota.*

G. B.—Gamaliel Bradford. Author of *Damaged Souls; Darwin; Lee, the American;* etc

G. B. A.—George Burton Adams. Former Professor of History, Yale University. Author of *Civilization During the Middle Ages;* etc.

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G. B. D.—George Bion Denton. Emeritus Professor of Dental History and Literature, Northwestern University, Evanston, Ill Special research worker, American Dental Association

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G. Bh.—Geoffrey Barraclough. Author of *The Origins of Modern Germany, Papal Provisions, Aspects of Church History, Constitutional, Legal and Administrative, in the Later Middle Ages.*

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G. C. Di.—George Campbell Dixon. Critic and playwright. Literary Editor, *The Daily Mail,* London, 1925–31. Author of *From Melbourne to Moscow;* etc.

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G. C. M.—George Campbell Macaulay. Former Lecturer in English, Cambridge University Former Professor of English Language and Literature, University of Wales Edited the *Works of John Gower.*

G. C. Mi.—George Charles Miller. Printer and instructor for many etchers and lithographers in America, including George Bellows, Rockwell Kent, Thomas H Benton, Grant Wood and others.

G. C. Ml.—George Catlett Marshall. General of the Army, U S. Army President, American Red Cross. U S Secretary of State, 1947–49 Chief of Staff, U S. Army, 1939–45.

G. C. Ms.—Geoffrey Christopher Morris. Fellow and Director of Studies in History, King's College, Cambridge. University Lecturer in History, Cambridge University.

G. C. N.—Grover C. Neff. President, Wisconsin Power and Light Company, Madison, Wis.

G. Co.—Georges Contenau, M.D. Director-General of Archaeological Missions in Iran.

G. C. R.—Guy Colwin Robson. Assistant Keeper in the Department of Zoology, British Museum (Natural History), London, 1931–36.

G. C Rh.—George C Rhodes. Director and General Passage Manager, Compagnie Générale Transatlantique

G. Cri.—George W. Crile, M.D. Chairman, Board of Regents, American College of Surgeons, 1917–39.

G. Ct.—George Calingaert. Director of Chemical Research, Ethyl Corporation, Detroit, Mich., 1932–

G. C-T.—Gertrude Caton-Thompson. President, Prehistoric Society, England, 1937–46 Director of Excavations in the Fayum for the Royal Anthropological Institute, 1927–28

G. C. W.—George C. Williamson. Author of *Portrait Miniatures;* etc.

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G. D. D.—G. D. Dunkerley. Former Secretary, Incorporated Association of Assistant Masters in Secondary Schools, England. Co-author, *The Assistant Master.* Co-editor, the *Journal of Education.*

G. de S.—Gaetano de Sanctis. Professor of Greek History, University of Rome, 1908–31 and 1945– . Professor of Ancient History, University of Turin, 1900–09.

G. D. H.—George Dames Hicks. Former Professor of Philosophy University College, University of London.

G. D. H. C.—George Douglas Howard Cole. Chichele Professor of Social and Political Theory, Oxford University. Author of *The World of Labour; Building and Planning;* etc.

G. Dk.—George Dock, Jr. Author of *Why Birds Leave Home* and *Vast Mystery of the Flyways.*

G. Do.—George Dow. Information Agent, the London and North Eastern Railway Company.

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G. E. A.—George E. Armstrong, M.D. Major General, U S. Army The Surgeon General, U S. Army

G. E. B.—George Earle Buckle. Editor of *The Times,* London, 1884–1912. Editor of *Letters of Queen Victoria* Author of *The Life of Disraeli.*

G. E. Bs.—George Edwin Bogaars. Civil Servant, British Colonial Administrative Service.

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G. Ed.—Rev. Gerald Ellard, S.J. Professor of Liturgical Theology, St Mary's College House of Theological Studies for Members of the Society of Jesus, St Marys, Kan. Author of *Christian Life and Worship; Men at Work at Worship,* etc.

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G. E. Hy.—Godfrey Eric Harvey. Indian Civil Service (Burma), 1912–35. Lecturer in Burmese, Oxford University, 1935–41. Author of *Outline of Burmese History: History of Burma; British Rule in Burma 1824–1942.*

G. E. K.—George Eden Kirk. Middle East Specialist. Royal Institute of International Affairs, Chatham House, London Author of *A Short History of the Middle East; Survey of International Affairs, 1939–45.*

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G. Es.—Gardner Emmons. Consulting meteorologist.

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G. E. W.—George Earle Wakerlin. Head of the Department of Physiology, College of Medicine, University of Illinois, Chicago, Ill Author of *Laboratory Manual of Human Physiology.*

G. E. W. C.—G. E. W. Crowe. Household labour saving expert.

Ge. W. S.—George W. Spicer. Professor of Political Science, University of Virginia, Charlottesville, Va Author of *The Constitutional Status and Government of Alaska; Fifteen Years of County Manager Government in Virginia*

G. F. B.—George Frederick Barwick. Keeper of Printed Books, British Museum, London, 1914–19. Assistant Keeper and Superintendent, Reading Room, British Museum, 1900–14.

G. F. H.—Sir George Francis Hill. Director, British Museum, London, 1931–36. Keeper, Department of Coins and Medals, British Museum, 1912–30. Author of *Sources of Greek History, 478–431* B.C ; *Handbook of Greek and Roman Coins;* etc.

G. F. K.—George Frederick Kunz. Former Honorary Curator of Precious Stones, American Museum of Natural History, New York, N.Y. Vice-President and Gem Expert, Tiffany and Company, New York, N.Y., 1879–1932. Author of *Gems and Precious Stones of North America;* etc.

G. F. M. C.—Sir Gilbert Francis Montriou Campion. Formerly Clerk of the House of Commons. Author of *An Introduction to the Procedure of the House of Commons.*

G. F. S.—Sir George Frederic Still, M.D. Physician Extraordinary to the King, 1937–41. Former Consulting Physician for Diseases of Children, King's College Hospital Author of *Common Disorders and Diseases of Childhood; History of Pediatrics;* etc

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G. F. Sw.—Gustavus Franklin Swift. Vice-Chairman of the Board, Swift and Company, Chicago, 1881–1943

G. F. Z.—George Frederick Zimmer. Former Consulting Engineer and Co-editor of *Engineering and Industrial Management* Author of *The Mechanical Handling and Storing of Material*

G. G.—George Glasgow. Author of *The Minoans; Ronald Burrows: A Memoir; From Dawes to Locarno; MacDonald as a Diplomatist;* etc

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G. G. A. M.—George Gilbert Aimé Murray. Regius Professor of Greek, Oxford University, 1908–36 Charles Eliot Norton Professor of Poetry, Harvard University, 1926 Author of *Rise of the Greek Epic;* etc.

G. G. B.—George Gordon Battle. Attorney-at-Law, member of the firm of Battle Levy, Fowler and Neaman, New York, N Y

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G. G. N.—G. G. Nearing. Horticulturist. Author of *The Lichen Book*.

G. Go.—Gerald Gould. Associate Editor of *The Daily Herald*, 1919–22.

G. G. P.—George Grenville Phillimore. Barrister-at-Law, Middle Temple.

G. Gr.—Gilbert Hovey Grosvenor. President, National Geographic Society, Washington, D C, 1920– Author of *History of National Geographic Society*

G. G. S.—George Gregory Smith. Professor of English Literature at Queen's University, Belfast, 1909–30 Author of *Scottish Literature: Character and Influence*, etc

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G. Hs.—Granville Hicks. Author of *The Great Tradition; John Reed* Co-editor of *The Letters of Lincoln Steffens*

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G. Ja.—George Jack. Architect and wood carver

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G. J. T.—George James Turner. Former Editor of *Select Pleas of the Forests* for the Selden Society.

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G. K A. B.—Rt Rev. George Kennedy Allen Bell, D D. Bishop of Chichester, England Dean of Canterbury, 1924–29 Author of *The Meaning of the Creed, Documents Bearing on the Problem of Christian Unity and Fellowship, The Modern Parson;* etc

G. K. C.—Gilbert Keith Chesterton. Author and journalist Author of *Dickens;* etc

G. K N.—G Kingsley Noble. Curator of Herpetology, American Museum of Natural History, New York, N Y, 1919–40 Author of *The Biology of the Amphibia*

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G. L. H.—George Leslie Harrison. President of the Federal Reserve Bank of New York, 1936–40

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G. L. K.—Geoffrey Langdon Keynes, M. D. Edited *Writings of William Blake*. Author of *William Blake;* etc.

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**G. L. P.—Grace L. Pennock.** Associate Editor, *Ladies' Home Journal*

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**G. L. T.—George L. Trager.** Professor of [illegible] Institute of Languages and [illegible] University, Washington, [illegible] *Analysis of Culture; Outline of English Structure.*

**G. L. W.—George L. Warren.** Adviser on Refugees and Displaced Persons, U.S. Department of State, Washington, D.C.

**G. M.—Sir George MacDonald.** President, Society of Antiquaries of Scotland, 1933–40.

**G. Ma.—Sir George Fletcher MacMunn.** Lieutenant General. Commander in Chief, Mesopotamia, April 1919 to January 1920. Author of *The Armies of India.*

**G. Mar.—G. Martin.** Superintendent, Rubber Investigations, Imperial Institute London.

**G. M. A. R.—Gisela Marie Augusta Richter.** Curator of the Greek and Roman Department, Metropolitan Museum of Art, New York, N Y Author of *Catalogue of Engraved Gems of the Classical Style in the Metropolitan Museum of Art;* etc.

**G. Mc.—Gilbert McAllister.** Member of Parliament Co-author of *Town and Country Planning;* joint editor of *Homes, Towns and Countryside.*

**G. M. Ca.—Gerald M. Capers.** Professor and Chairman of the Department of History, H. Sophie Newcomb Memorial College for Women, Tulane University, New Orleans, La. Author of *Biography of a River Town.*

**G. M. Ce.—Gerald M. Clemence.** Senior Astronomer, U S Naval Observatory, Washington, D C.

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**G. M. Dk.—Gail M. Dack, M.D.** Director, Food Research Institute, The University of Chicago Author of *Food Poisoning.*

**G. M. G.-H.—Geoffrey Malcolm Gathorne-Hardy.** Author of *The Norse Discoverers of America; Norway; A Short History of International Affairs, 1920–39.*

**G. Mh.—Geoffrey Mott-Smith.** Editor of *The Bridge World,* 1936–46. Editor of *Games Digest,* 1938–39. Author of *Mathematical Puzzles;* etc.

**G. Mi.—Rev. [illegible]** Professor [illegible] Biblical Criticism in the University of Chicago, 1906–34. Author of *The Theology of the Epistle to the Hebrews;* etc.

**G. Ml.—Gabriel Marcel.** Dramatist and literary critic for *L'Europe nouvelle* Author of *Studies on Contemporary English and American Philosophers*

**G. M. McB.—George McCutchen McBride.** Professor of Geography, University of California, Los Angeles. Visiting Professor, Carnegie Endowment for International Peace, South America, 1929–30; Central America, 1938. Author of *Agrarian Indian Communities of Highland Bolivia;* etc.

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**G. M. S. S.—George Marquis Stewart Stitt.** Commander, Royal Navy (retired). Cabinet Office Historian, Great Britain. Author of *H M S. Wideawake; A Prince of Arabia; Under Cunningham's Command.*

**G. M. T.—Galen M. Taylor.** Lieutenant Colonel, Ordnance Department, U.S. Army.

**G. M. W.—George Mackinnon Wrong.** Former Professor of History, University of Toronto, Canada.

**G. M. Ws.—George Michael Wickens.** University Lecturer in Arabic, Cambridge.

**G. N. C.—George Norman Clark.** Provost of Oriel College, Oxford, 1947– . Chichele Professor of Economic History and Fellow of All Souls College, Oxford, 1931–43 Regius Professor of Modern History Cambridge University, 1943–47 Author of *The Dutch Alliance and the War Against French Trade;* etc

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**G. P. DuS.—Graham Phillips DuShane.** Professor of Biology, Stanford University, Stanford, Calif.

**G. P. E.—George Pearse Ennis.** Former member, American Water Color Society. Guild of American Painters, Society of Painters, etc.

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**G. P. T.—George Philip Thomson.** Reader in the Royal Naval Public Relations Officer Hispanic Counter and Luso-Brazilian Council, London Chief Press Censor, Ministry of Information, London, 1940–45 Author of *Blue Pencil Admiral.*

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**G. R. C.—George Rowland Collins.** Professor of Marketing and Dean, Graduate School of Business Administration, University College of Arts and Pure Science, New York University Author of *Marketing; An Outline of Business;* etc

**G. R. D.—Godfrey Rolles Driver.** Grinfield Lecturer on the Septuagint, Oxford University, 1935–39. Professor of Semitic Philology, 1938.

**G. R. de B.—Gavin Rylands de Beer.** Professor of Embryology, University College, University of London. Former Head of Department of Anatomy and Embryology Jenkinson Lecturer in Embryology, 1927–38, and Senior Demonstrator in Zoology, Oxford University, 1926–38. Author of *Vertebrate Zoology; Embryos and Ancestors;* etc.

**G. Re.—Sir George Reid.** Scottish artist.

**G. R. F. B.—G. R. F. Bredin.** Fellow and Bursar of Pembroke College, Oxford, 1950– . Governor of Blue Nile Province, Anglo-Egyptian Sudan, 1941–48.

**G. R. P.—George Richard Potter.** Professor of Modern History, University of Sheffield, Sheffield, Eng Author of *The [illegible] of Ousama; Short History of Scandinavia; Sir Thomas Mac.*

**Gr. P. B.—Gregory Paul Baxter.** Former Theodore William Richards Professor of Chemistry, Harvard University.

**G. R. R.—G. R. Rudolf.** Average adjuster Co-editor of *Loundes' Law of General Average.*

**G. Rs.—Graham Reynolds.** Deputy Keeper, Department of Paintings, Victoria and Albert Museum, London. Author of *English Portrait Miniatures; Nicholas Hilliard and Isaac Oliver.*

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**Gru.—M. Gruson.** General Secretary, Compagnie des Chemins de Fer de l'Est, Paris

**G. S.—Grant Showerman.** Professor of Latin in the University of Wisconsin, Madison, Wis, 1900–35. Author of *The Great Mother of the Gods.*

**G. Sa.—George Edward Bateman Saintsbury.** Essayist and critic Former Professor of Rhetoric and English Literature at Edinburgh University Author of *Essays on French Novelists;* etc.

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G. S. J.—Gilbert Starling Jones. Executive Vice-President and Treasurer, Valley Forge Historical Society, Valley Forge, Pa. Author of *Valley Forge Park, An Historical Record and Guide.*

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G. Ste.—George Stevenson, M.D. Medical Director, the National Committee for Mental Health, Inc Co-author of *Child Guidance Clinics*

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G. S. W. E.—Sir George Selby Washington Epps. Actuary, Government Actuary's Department, London, 1936–44; Deputy Actuary, 1926–36

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G. T. G.—Sir George Taubman Goldie. Former English Administrator and Founder of Nigeria.

G. T. M.—Sir Gilbert Thomas Morgan. Director, Chemical Research Laboratory, Department of Scientific and Industrial Research, London, 1925–38. Former Mason Professor of Chemistry, University of Birmingham. Author of *Inorganic Chemistry;* etc.

G. T. N.—Gordon Thayer Nightingale. Physiologist, Hawaiian Pineapple Company, Honolulu, Hawaii.

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G. T. W.—Sir Gilbert Thomas Walker. Professor of Meteorology, Imperial College of Science and Technology, University of London, 1924–34 Director General of Indian Observatories, 1904–24 Fellow of Trinity College, Cambridge, 1891. Author of *Aberration; The Theory of Electromagnetism;* etc.

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G. W. Do.—George William Douglas. Former Associate Editor of the *Evening Public Ledger* and of the *Philadelphia Public Ledger* Author of *The American Book of Days,* etc.

G. W. G.—George W. Giles. Secretary of the Allotments Organization Society and Small Holders, Ltd.

G. W. Gi.—George Waters Gilbertson. Author of *The Balochi Language,* etc.

G. W. Go.—George Washington Goethals. Former Instructor in Civil and Military Engineering, U S Military Academy, West Point, N Y Chief Engineer, Panama Canal, 1907–14 Civil Governor, Panama Canal Zone, 1914–16. State Engineer, New Jersey, 1917.

G. W. H.—George William Heise. Research Chemist, National Carbon Company, Cleveland, O.

G. W. K.—George Williams Keeton. Professor of English Law and Dean, Faculty of Laws, University College, University of London Editor of *The Cambridge Review,* 1924 Author of *The Elementary Principles of Jurisprudence,* etc.

G. W. Ki.—George W. Kirchwey. Head of the Department of Criminology, New York School of Social Work, 1917–32 Warden of Sing Sing Prison, 1915–16 Author of *Readings in the Law of Real Property.*

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G. W. O.—Gerrit Willem Overdijkink. Expert on southeast Asian affairs.

G. W. R.—George William Redway. Author of *The War of Secession, 1861–62; Fredericksburg: A Study in War.*

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**H. E.—Haven Emerson, M.D.** Professor of Public Health Administration, Columbia University, 1922–40. Editor of *Alcohol and Man;* etc.

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J. B. B.—John Bagnell Bury. Regius Professor of Modern History, Cambridge University, 1902–27, Regius Professor of Greek, Trinity College, Dublin, 1898–1902 Author of *History of the Roman Empire 27 B.C.–180 A.D.*, etc Editor of Gibbon's *Decline and Fall of the Roman Empire* (1896–1900).

**J. B. Ba.—Sir James B. Baillie.** Vice-Chancellor, University of Leeds, England, 1924-38. Professor of Moral Philosophy, University of Aberdeen, Scotland, 1902–24.

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**J. B. H.—James Brents Hill.** President of the Louisville and Nashville Railroad Company, Louisville, Ky., 1934–50

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**J. B. Se.—John B. Spore.** Editor, *Combat Forces Journal.*

**J. B. S. H.—John Burdon Sanderson Haldane.** Professor of Biometry, University College, University of London. Fullerian Professor of Physiology, Royal Institution, 1930–32; Professor of Genetics, University of London, 1933-37. Author of *Animal Biology* (with J. S. Huxley); *The Causes of Evolution;* etc.

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**J. C. A.—James Coats Auchincloss.** Congressman, 1943–53. Former President, The Better Business Bureau of New York, N.Y.

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**J. C. E.—James Chidester Egbert.** Professor of Latin, 1906–42, and Director, University Extension, 1910–42, Columbia University. General Editor of Macmillan's Series of Latin Classics. Author of *Introduction to the Study of Latin Inscriptions;* etc.

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**J. C. Ms.—J. Clyde Marquis.** American Representative and Vice-President, International Institute of Agriculture, Rome, Italy, 1935–41. Former Director of Economic Information, U.S. Department of Agriculture.

**J. C. My.—Rev. John Courtney Murray, S. J.** Editor, *Theological Studies.*

**J. C. Ns.—Joseph C. Nichols.** Sports Department, the *New York Times.*

**J. C. O.—James C. Olson.** Superintendent, Nebraska State Historical Society. Author of *J. Sterling Morton.*

**J. C. Os.—John Clyde Oswald.** Former President of the New York Employing Printers Association, Inc. Former Editor of *The American Printer.*

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**J. E. Fi.—Joel E. Fisher.** Former President, American Alpine Club.

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**J. E. H.—John Edgar Hoover.** Director, Federal Bureau of Investigation, United States Department of Justice.

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**J. E. K.—James Edward Knott.** Professor of Truck Crops and Head of Division, College of Agriculture, University of California, 1940– .

**J. E. L.—Sir John Edward Lloyd.** Emeritus Professor of History, University College of North Wales, Bangor, 1930–47 Former President of the Welsh Language Society. Author of *A History of Wales to the Edwardian Conquest;* Editor of Hubert Lewis' *Ancient Laws of Wales*

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**J. E. Me.—Joseph Earle Moore, M.D.** Associate Professor of Medicine, The Johns Hopkins University, 1916–45, Physician-in-charge, Syphilis Division, Medical Clinic, The Johns Hopkins Hospital, Baltimore, Md. Author of *The Modern Treatment of Syphilis;* etc.

**J.-E.-M.-G. D.—Joseph-Edouard-Marie-Ghislain Delmelle.** Honorary President of Jeunes Écrivains Belges. Author of *Histoire des lettres belges d'expression française, Panorama de la jeune poésie française en Belgique; Profondeur de la mer;* etc.

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**J. En.—Jeannette Eckman.** Historian and Director, New Castle Tencentenary Commission.

**J. E. S.—John Edward Sears.** Former Superintendent of Metrology Department, National Physical Laboratory, England.

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**J. Fo.—Sir John William Fortescue.** Librarian at Windsor Castle, 1905–26. Author of *Wellington; History of the 17th Lancers;* etc.

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**J. G. K.—Sir John Graham Kerr.** M.P. (Nat. Govt.), Scottish Universities, 1935–50. Regius Professor of Zoology, University of Glasgow, Scotland, 1902–36. Author of *Textbook of Embryology;* etc.

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**J. G. R-S.—John Graham Royde-Smith.** Writer.

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**J. H. Hl.—Jerome Hall.** Professor of Law, Indiana University, Bloomington, Ind Author of *Living Law of Democratic Society; Theft, Law and Society.*

**J. H. L.—John Howland Lathrop, D.D.** Pastor. First Unitarian Congregational Church, Brooklyn, N.Y. Author of *Toward Discovering a Religion.*

**J. H. Lh.—John Hugh Loch.** Officer in the British Colonial Administrative Service (Malayan Civil Service)

**J. H. M.—J. Hamish Miles.** Author (with R. Mortimer) of *The Oxford Circus.*

**J. H. MacD.—J. H. MacDonald.** Budget Officer, National Broadcasting Company. Author of *Practical Budget Procedure,* etc.

**J. H. McG.—James Howard McGregor.** Associate in Human Anatomy, American Museum of Natural History, New York, N.Y., 1916– ; Professor of Zoology, Columbia University, 1924–42.

**J. H. Mi.—John Henry Middleton.** Art Director, Victoria and Albert Museum, London, 1892–96 Slade Professor of Fine Art, Cambridge University, 1886–95 Director of the Fitzwilliam Museum, Cambridge, 1899–92. Author of *The Engraved Gems of Classical Times;* etc.

**J. H. Mn.—John Holmes Martin.** Senior Agronomist in charge of Sorghum and Broomcorn Investigations, Bureau of Plant Industry, Agricultuial Research Administration, U.S. Department of Agriculture, 1925–

**J. H. Mo.—John Hartman Morgan.** Brigadier General Honorary Adviser to American War Crimes Commission, Nuernberg, Germany, 1947 Emeritus Professor of Constitutional Law in the University of London

**J. H. Mu.—John Henry Muirhead.** Former Professor of Philosophy in the University of Birmingham, England Author of *Elements of Ethics;* etc Editor of *Library of Philosophy.*

**J. H. My.—John H. Manley.** Professor of Physics, University of Washington, Seattle, Wash.

**J. Hn.—Julie Helen Heyneman.** Portrait painter.

**J. H. Nu.—Joseph Henry Nuelle.** President, Member of Executive Committee and Director, The Delaware and Hudson Company, New York, N.Y., 1938–

**J. Ho.—Josef Hoffmann.** Professor at the School of Industrial Arts at Vienna. Art Director of the Wiener Werkstatte.

**J. H. Os.—J. H. Osborne.** Chairman, Merryweather and Sons, Ltd., London.

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**J. H. Par.—Julius Hall Parmelee.** Vice-President, Association of American Railroads (1947– ). Author of *The Modern Railway.*

**J. H. Pe.—John H. Paige.** President, United States Intercollegiate Lacrosse Association. Member, Lacrosse Referees Association.

**J. H. Py.—John Horace Parry.** Professor of Modern History, University College of the West Indies, Mona, Jamaica Author of *The Audiencia of New Salicia; Europe and a Wider World; The Spanish Theory of Empire.*

**J. Hr.—John Hightower.** Kennel Editor and Manager of "Where to Go" department, and member of the general editorial staff of *Field & Stream.*

**J. H. R.—John Horace Round.** Former Historical Adviser to the Crown. President, Essex Archaeological Society, 1916–21. Author of *Feudal England; Peerage and Pedigree;* etc.

**J. H. Rn.—John Henry Richardson.** Professor of Industrial Relations, University of Leeds, Leeds, Eng Author of *British Economic Foreign Policy; Industrial Relations in Great Britain.*

**J. H. Ro.—John Holland Rose.** Vere-Harmsworth Professor of Naval History, Cambridge University, 1919–37 Reader in [illegible], Cambridge, 1911–19 Author of *The Development of the European Nations, 1870–1900;* etc.

**J. H. Rob.—James Harvey Robinson.** Former Professor of History, Columbia University. Author of *The Mind in the Making;* etc

**J. H. Rs.—James Hardy Ropes, D.D.** Former Professor of Divinity and Dexter Lecturer on Bible Literature, Harvard University.

**J. H. Ry.—Most Rev. James Hugh Ryan, S.T.D.** Bishop of Omaha, Neb., 1935–47. Former Professor of Philosophy and Rector, Catholic University of America, Washington, D.C. Author of *Directory of Catholic Colleges and Schools;* etc.

**J. H. Sd.—Julian H. Steward.** Graduate Research Professor of Anthropology, University of Illinois, Urbana, Ill Editor of *Handbook of South American Indians*

**J. H. Sr.—J. H. Sinclair.** Geologist and explorer. Author of *Explorations in Eastern Ecuador.*

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**J. Ht.—James Hart.** Professor of Political Science, University of Virginia, Charlottesville, Va. Author of *Tenure of Office Under the Constitution;* etc.

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**J. Hud.—Joseph Hudnut.** Professor of Architecture and Dean of the Faculty of Design, Harvard University. Author of *Modern Sculpture;* etc.

**J. H. V. C.—John Henry Verinder Crowe.** Brigadier General. Commandant of the Royal Military College of Canada, 1909–13. Former Chief Instructor in Military Topography and Military History and Tactics, Royal Military Academy, Woolwich, England. Author of *Epitome of the Russo-Turkish War, 1877–78;* etc.

**J. H. V. V.—J. H. Van Vleck.** Dean of Applied Science and Hollis Professor of Mathematics and Natural Philosophy, Harvard University. Author of *Quantum Principles and Line Spectra; The Theory of Electric and Magnetic Susceptibilities.*

**J. H. Wi.—John H. Wigmore.** Colonel. Professor of Law, 1893–1943, and former Dean of Faculty of Law, Northwestern University, Evanston, Ill. Author of *Panorama of the World's Legal Systems;* etc.

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**J. H. Y.—John H. Yoe.** Professor of Chemistry, University of Virginia, Charlottesville, Va. Author of *Photometric Chemical Analysis; Chemical Principles; Qualitative Analysis;* etc.

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**J. I. C.—John I. Cooper.** Assistant Professor of History, McGill University, Montreal, Quebec, Canada.

**J. I. G.—John Inkster Goodlad.** Professor of Education and Director of the Division of Teacher Education, Emory University, Ga

**J. I. P.—John Isaac Platt.** Lecturer in Geology, University College of Wales, Aberystwyth.

**J. Is.—Jacob Isaacs.** Professor of English Language and Literature, University of Jerusalem, 1942. Lecturer in English Literature at King's College, University of London, 1928–42. Author of *Shakespeare as Man of the Theatre;* etc.

**J. Ja.—Joseph Jacobs.** Former Professor of English Literature in the Jewish Theological Seminary, New York, N.Y. Author of *Jews of Angevin England.*

**J. J. C.—John J. Collyer.** Brigadier General. Former Officer of the Legion of Honour. Former Chief of the General Staff, Union of South Africa.

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**J. J. H.—Rev. John J. Healy, S.J.** Professor of Fundamental Theology, Alma College, Alma, Calif.

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**J. J. Le.—James J. Lingane.** Professor of Chemistry, Harvard University. Co-author of *Polarography.*

**J. J. M.—James Joseph Mallon.** Warden of Toynbee Hall, London. Honorary Secretary of Trade Boards Advisory Council. Honorary Adviser to the Minister of Food on feeding in air raid shelters.

**J. J. McC.—John Jay McCloy.** U.S. High Commissioner in Occupied Germany, 1949–52. U.S. Assistant Secretary of War, 1941–45.

**J. Jn.—John Jackson.** H.M. Astronomer, Cape of Good Hope, 1933–50.

**J. J. O'N.—John Johnston O'Neill.** Dean of Engineering and Vice-Principal of McGill University, Montreal, Que.

**J. J. P.—John Joseph Pershing.** General of the Armies of the United States. Chief of Staff, U.S. Army. 1921–24. Commander-in-Chief, American Expeditionary Forces in Europe, 1917–19 Author of *My Experiences in the World War*

**J. J. R.—Joseph James Runner.** Professor of Geology, State University of Iowa, Iowa City, Ia. Senior Geologist, U.S. Geological Survey, 1942– .

**J. J. R. MacL.—John J. R. MacLeod.** Former Regius Professor of Physiology, University of Aberdeen, Scotland Former Professor of Physiology, University of Toronto, Canada Winner of Nobel Prize for Medicine, 1923.

**J. J. Sn.—John J. Sheehan.** Public Relations Director, American Stock Exchange, New York, N.Y.

**J. J. T.—John James Tigert.** President of the University of Florida, Gainesville, Fla. United States Commissioner of Education, 1921–28. Author of *Philosophy of the World War,* etc

**J. K.—John King.** Former Chairman of the National Light Castings Association.

**J. K. F.—J. K. Fotheringham.** Former Reader in Ancient Astronomy and Chronology in Oxford University Honorary Assistant in the University Observatory, Oxford, 1925–36

**J. K. G.—James K. Gaynor.** Lieutenant Colonel, U.S. Army. Chief, New Trial Division, Office of the Judge Advocate General of the Army.

**J. K. H.—John Knowles Herr.** Major General, U.S.A. (retired) Chief of Cavalry, Washington, D.C., 1938–42 Assistant Chief of Staff, American Forces in Germany, 1921–22. Director G-2, Army War College, 1932

**J. K. H. W.—J. K. H. Wilde.** Chief Veterinary Officer of Nigeria.

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**J. L.—Julien Luchaire.** General Inspector of Public Instruction, 1920– . Director of the International Institute of Intellectual Cooperation, Paris, 1925–31.

**J. La.—Sir Joseph Larmor.** Former Fellow of St. John's College, Cambridge. Lucasian Professor of Mathematics in Cambridge University, 1903–32. Professor of Natural Philosophy, University College, Galway, and in the Queen's University of Ireland, 1880–85. Author of *Ether and Matter;* etc.

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**J. LaF.—The Reverend John LaFarge, S.J.** Associate Editor, *America.* Author of *Interracial Justice; Jesuits in Modern Times; No Postponement.*

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**J. L. H.—John Lawrence Le Breton Hammond.** On editorial staff, *Manchester Guardian,* 1939–49. Co-author of *The Village Labourer, 1760–1832; The Town Labourer, 1760–1832; The Skilled Labourer, 1760–1832;* etc.

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**J. L. L.—John Livingston Lowes.** Former Professor of English and Dean of the Graduate School of Arts and Sciences, Harvard University. Author of *Convention and Revolt in Poetry.*

**J. L. La.—Jesse L. Lasky.** Associate Producer, RKO Radio Pictures, Inc. Former Vice-President, Paramount-Publix Corporation, and President, Pickford-Lasky Productions, Inc.

**J. L. Lh.—Jay Laurence Lush.** Professor of Animal Breeding, Iowa State College, Ames, Iowa. Author of *Animal Breeding Plans.*

**J. L. M.—J. Leask Manson.** Sometime Technical Officer, Department of Scientific and Industrial Research, London.

**J. L. My.—Sir John (Linton) Myres.** Chairman, British School at Athens, 1934–47. Former Fellow and Librarian of New College, Oxford. General Secretary, International Congress Anthropological and Ethnological Sciences, 1934–47. Wykeham Professor of Ancient History in Oxford University, 1910–39. Frazer Lecturer, Cambridge University, 1943 Author of *The Dawn of History; The Political Ideas of the Greeks;* etc.

**J. L. N.—John Lloyd Newcomb.** President, University of Virginia, Charlottesville, Va., 1933–46.

**J. L. S.—Julian Larcombe Schley.** Major General. Former Director of Transportation, Office Coordinator Inter-American Affairs. Chief of Engineers, U.S. Army, 1937–41. Governor Panama Canal, 1932–36; Director Panama Railroad Company, 1928– .

**J. L. T.—John L. Thornton.** Librarian, St. Bartholomew's Hospital Medical College, London. Author of *A Chronology of Librarianship; Medical Books, Libraries and Collectors; A Mirror for Librarians;* etc.

**J. L. W.—Jessie L. Weston.** Author of *Arthurian Romances.*

**J. L. We.—Joseph Lee Weiner.** Director of Civilian Supply, War Production Board, 1941–43. Director Public Utilities Division, Securities and Exchange Commission, 1939–41.

**J. Ly.—John Lansbury, M.D.** Associate Professor [illegible] School of Medicine, Temple University, Philadelphia, Pa.

**J. M.—James MacKinnon, D.D.** Professor of Ecclesiastical History in the University of Edinburgh, Scotland, 1908–30. Author of *The Origins of the Reformation; Luther and the Reformation;* etc.

**J. M. A.—John Morris Arthur.** Biochemist, Boyce Thompson Institute for Plant Research, Yonkers, N.Y., 1921– .

**J. Mac.—Sir John MacDonell.** Former Master of Supreme Court, Quain Professor of Comparative Law, University College, University of London, and Editor of *State Trials; Civil Judicial Statistics;* etc Author of *Survey of Political Economy;* etc.

**J. M. At.—John Murray Atwood, D.D.** Dean, Theological Department, St. Lawrence University, Canton, N.Y 1914–51 President of New York State Convention of Universalists, 1927–29 and 1940–42.

**J. M. Bl.—John Mann Beal.** Professor of Botany, The University of Chicago.

**J. M. C.—Rev. John Martin Creed.** Former Ely Professor of Divinity, Cambridge University. Former Canon of Ely.

**J. McG.—J. E. M. McGregor.** Office of the Engineer-in-Chief, General Post Office, London, Eng.

**J. M. Cn.—Jose M. Calderon.** President, Calderon and Company, Inc., New York, N.Y.

**J. M. Cy.—John M. Carmody.** Member, General Review Board, War Assets Administration, 1947–48 Chairman, Maritime War Emergency Board, 1946–47 Member, Maritime Commission, 1941–46. Administrator, Federal Works Agency, Washington, D.C., 1939–41.

**J. M. D.—John M. Davis.** Former President, Delaware, Lackawanna and Western Railroad Co., New York, N.Y. President, Manning, Maxwell, & Moore, Inc, 1920–25.

**J. M. de N.—J. M. de Navarro.** Former Fellow of Trinity College, Cambridge.

**J. M. G.—John Merriman Gaus.** Professor of Government, Harvard University Author of *Reflections on Public Administration;* co-author of *Frontiers of Public Administration.*

**J. M. Gy.—Sir John Milner Gray.** Former Chief Justice of Zanzibar. Author of *Biographical Notes of the Mayors of Cambridge; A History of the Perse School, Cambridge; The School of Pythagoras.*

**J. M. Hs.—John Moore Hills.** Consulting geologist.

**J. M. Hy.—Joan Mervyn Hussey.** Professor of History, University of London. Author of *Church and Learning in the Byzantine Empire, 867–1185.*

**J. M. K.—James Moss Ketch.** Illuminating Engineer, National Lamp Works of General Electric Company, Cleveland, O. Author of *Cotton Mill Lighting.*

**J. M. Ku.—James M. Kurn.** Former Trustee, St. Louis-San Francisco Railway Company, St. Louis, Mo.

**J. M. L.—James Miller Leake.** Professor and Head of the Department of History and Political Sciences, University of Florida, Gainesville, Fla, 1919–50. Author of *History of Florida.*

**J. M. La.—James MacCauley Landis.** Chairman, [illegible] Board, 1946–47. Dean of the Faculty of Law, Harvard University, 1937–46 Director, U S Office of Civilian Defense, 1942–43. Director of American Economic Operations and Minister to Middle East, 1943–45 Co-author of *The Business of the Supreme Court;* Author of *Cases on Labor Law;* etc

**J. M. M.—John Malcolm Mitchell.** Secretary, Carnegie United Kingdom Trust, 1919–39 President, Library Association, 1931–32. Author of *The Public Library System of Great Britain and Ireland;* editor of *The Rural Libraries Handbook.*

**J. M. Mag.—John MacArthur Maguire.** Professor of Law, Harvard University. Author of *The Lance of Justice, a Semi-Centennial History of the Legal Aid Society;* etc.

**J. M. Me.—James Malcolm Milne.** Barrister-at-Law.

**J. M. Mk.—Joseph M. Michalak.** Assistant Editor, *Electrical World.*

**J. Mn.—John MacPherson, M.D.** Former Inspector-General of Hospitals, Bengal, India.

**J. M. N.—John Macarthur Nicolle.** Secretary of Trinity House Corporation, London, 1935–46.

**J. Mo.—John Morley, 1st Viscount Morley of Blackburn.** Lord President of the Council, 1910–14. Secretary of State for India, 1905–10. Author of *Edmund Burke;* etc.

**J. Mof.—Rev. James Moffatt, D.D.** Washburn Professor of Church History, Union Theological Seminary, New York, N.Y., 1927–39. Yates Professor of Greek and New Testament Exegesis, Mansfield College, Oxford, 1911–15 Professor of Church History, United Free College, Glasgow, Scot, 1915–27. Former Editor of the *Expositor.* Author of *Critical Introduction to New Testament Literature;* etc.

**J. Mos.—John Moss.** Public Assistance Officer for Kent, Eng Author of *Health and Welfare Services Handbook.*

**J. M. P. S.—J. M. Powis Smith.** Professor of Oriental Languages and Literature, The University of Chicago, 1915–32 Former Editor of the *American Journal of Semitic Languages and Literature.*

**J. M. R.—John Mackinnon Robertson.** Author of *Montaigne and Shakespeare; Modern Humanists; The Problems of the Shakespeare Sonnets.*

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**J. Ms.—Rt. Rev. Monsignor J. Moyes, D.D.** Former Canon of Westminster Cathedral, London. Former Editor of *The Dublin Review* and Domestic Prelate to H.H. Pope Benedict XV.

**J. M. Sc.—J. M. Scammell.** Former Assistant in History and Lecturer in Political Science, University of California.

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**J. Mt.—Jean Martet.** Private Secretary to M. Clemenceau.

**J. M. T.—James Matthew Thompson.** Honorary Fellow of Magdalen College, Oxford Author of *The French Revolution; Leaders of the French Revolution; Napoleon Bonaparte, Robespierre.*

**J. Mu.—John Mulholland.** Member of Society of American Magicians. Author of *Quicker Than the Eye; Story of Magic;* etc. Editor of *The Sphinx,* professional magazine of magic.

**J. M. W-H.—John Michael Wallace-Hadrill.** Fellow and Tutor of Merton College, Oxford. Author of *The Barbarian West, 400–1000.*

**J. M. Wr.—J. Marvin Weller.** Professor of Invertebrate Palaeontology, The University of Chicago.

**J. M. Wt.—James Muir Watt.** Joint Assistant Secretary, The Chartered Auctioneers' and Estate Agents' Institute, London Author of *The Agriculture Act, 1947, The Agricultural Holdings Act, 1948; The Landlord and Tenant (Rent Control) Act, 1949; The Leasehold Property (Temporary Provisions) Act, 1951.*

**J. N.—John Nichol.** Professor of English Literature, Glasgow University, Glasgow, Scotland, 1862–89. Author of *Robert Burns; Carlyle;* etc.

**J. Na.—James Naismith, M.D.** Formerly with Department of Physical Education, University of Kansas, Lawrence, Kan Author of *Basketball Rules.* Originator of the game of basketball.

**Jn. B.—John Blackmore.** General Church Historian, Reorganized Latter Day Saints Church.

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**J. P.-B.—James Penderel-Brodhurst.** Former Consulting Editor, Editor of *The Guardian,* London.

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**J. P. D.—James P. Dawson.** Former Boxing Editor, the *New York Times.*

**J. Pe.—Jean Perrin.** Former Professor of Physical Chemistry at the Sorbonne, Paris Nobel Prize for Physics, 1926.

**J. P. E.—Jean Paul Hippolyte Emmanuel Adhémar Esmein.** Former Professor of Law, University of Paris. Author of *Cours élémentaire d'histoire du droit français.*

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**J. Pi.—Jacques Pirenne.** Formerly Secretary to King Leopold III Professor of History of Civil Law, University of Brussels, 1924– Tutor to Prince Leopold of Belgium (later King Leopold III), 1920–24. Author of *A History of Europe.*

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**J. P. M.—James Philip Mills.** Former Assistant Commissioner, Makokehung, Assam. Fellow of Royal Asiatic Society of Bengal, India. Author of *The Lhota Nagas.*

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**L. Bo.—Lorraine Bouthilet.** Managing Editor, *The American Psychologist.*

**L. Bt.—Libby Benedict.** Author of *The Refugees*

**L. Ca.—Luis Cabrera.** Author of *The Heritage of Carranza,* published under the pseudonym Lic Blas Urrea.

**L. C. A.—Lincoln Clark Andrews.** Brigadier General (retired). Formerly in charge U S. Coast Guard and Prohibition Unit charged with enforcing the Volstead Act. Author of *Fundamentals of Military Service;* etc.

**L. Cam.—Rev. Lewis Campbell.** Professor of Greek and Gifford Lecturer, University of St Andrews, Scotland, 1863–94.

**L. C. C.—LaMont C. Cole.** Assistant Professor of Zoology, Cornell University, Ithaca, N Y.

**L. C. D.—L. C. Dunn.** Professor of Zoology, Columbia University, New York, N Y. Executive Head, Department of Zoology, 1940–46. Author of *Heredity and Variations;* etc.

**L. C. M.—Sir Leo Chiozza Money.** Member of the War Trade Advisory Committee, 1915–18. Parliamentary Secretary to the Ministry of Shipping 1915–18 Chairman of the Tonnage Priority Committee, 1917–18 Chairman of the National Maritime Board, 1917–18. Author of *The Nation's Wealth; Product Money;* etc.

**L. C. P.—Linus Carl Pauling.** Professor of Chemistry and Chairman, Division of Chemistry and Chemical Engineering, Director of Gates and Crellin Laboratories of Chemistry, California Institute of Technology, Pasadena, Calif Author of *Nature of the Chemical Bond;* etc.

**Ld.—Edward Arthur Henry Pakenham, Earl of Longford.** Director of the Dublin Gate Theatre Dublin, Ire. Author of *The Dove in the Castle; Poems From the Irish; More Poems From the Irish.*

**L. D.—Louis Marie Olivier Duchesne.** Former Professor at the Catholic Institute in Paris Former Director of the French School of Archaeology at Rome. Author of *Origines du culte chrétien, étude sur la liturgie latine avant Charlemagne;* etc

**L. D. B.—Leon Dexter Batchelor.** Director, University of California Citrus Experiment Station.

**L. D. C.—Lotus Delta Coffman.** Former President of the University of Minnesota, Minneapolis, Minn.

**L. de B. H.—Louis de Breda Handley.** Author of *Sculling and Watermanship; Crawl Stroke Swimming;* etc.

**L. D. S.—Laurence Dudley Stamp.** Research Professor of Social Geography, University of London, 1948– . Chief Adviser to the Ministry of Agriculture on Rural Land Use, 1943– . Author of *An Introduction to Stratigraphy;* etc.

**L. Du. P.—Lammot Du Pont.** Former Chairman of the Board E. I. du Pont de Nemours and Company, Wilmington, Del.

**L. D. W.—Leonard Dupee White.** Professor of Public Administration, The University of Chicago. Author of *Whitley Councils in the British Civil Service;* etc.

**L. E.—Louis Eisenmann.** Ernest Denis Professor in Slavonic History, University of Paris Author of *Le compromis austro-hongrois de 1867;* etc.

**L. E. Bh.—Lloyd E. Blauch.** Chief, Education in the Health Professions, Office of Education, Federal Security Agency, Washington, D C Author of *A Course of Study in Dentistry, Teaching in Colleges and Universities With Special Reference to Dentistry;* etc.

**L. E. Bo.—LeRoy E. Bowman.** Director, United Parents' Association, New York, N.Y., 1935–38. Department of Social Science, Columbia University, 1917–31. Author of *Community Programs of Summer Play Schools;* etc.

**L. E. E.—Leslie Ernest Egginton.** Official of the Automobile Association, London.

**L. E. E.-B.—Leonard Elliott Elliott-Binns, D.D.** Vicar of St Newlyn East and Honorary Canon of Truro, England, 1943–45.

**L. E. F.—Laurence E. Falls.** Secretary-Treasurer, Insurance Institute of America, Inc, New York, N Y.

**L. E. G.—Linton E. Grinter.** Dean of the Graduate School, University of Florida, Gainesville, Fla. Author of *Design of Modern Steel Structures; Engineering Mechanics; Theory of Modern Steel Structures.*

**L. E. H.—Sir Leonard Erskine Hill.** Director of Research, St John Clinic and Institute of Physical Medicine. Former Director of Applied Physiology, National Institute of Medical Research, Mount Vernon, Hampstead, England. Author of *Science of Ventilation and Open Air Treatment;* etc.

**L. E. M.—L. E. Moffatt.** Former Managing Editor of *Electrical Merchandizing,* New York, N.Y.

**L E. T.—Leon E. Truesdell.** Chief Demographer, Bureau of the Census, U.S Department of Commerce, Washington, D C. Author of *The Canadian Born in the United States; Farm Population of the U.S.;* etc.

**L. E. V. C.—Louis Emilien Victor Cordonnier.** General Commanded the French Army in the East under General Sarrail. Author of *The Japanese in Manchuria.*

**L. F. A.—Ludwig Frederick Audrieth.** Professor of Chemistry, University of Illinois, Urbana, Ill. Editor in Chief of *Inorganic Synthesis,* 1946– .

**L. F. B.—Lewellys F. Barker, M.D.** Former Professor of Medicine, The Johns Hopkins University, Baltimore, Md.

**L. F. C.—Leslie Frederic Church.** Honorary Editor, *The Methodist Church in Great Britain and Ireland.* Author of *The Early Methodist People.*

**L. F. G.—Laurence Frederick Graber.** Head of Agronomy Department, University of Wisconsin, Madison, [illegible] of *Agronomy, Principles and Practices;* etc

**L. F. M.—Louis F. Marr.** Staff Member, Industrial Department (Labour Relations), Detroit Bo[illegible] of Commerce, Detroit, Mich.

**L. F. S.—Louis Francis Salzman.** Editor, *Victoria County Histories.* Author of *English Industries of the Middle Ages;* etc.

**L. F. Sh.—Leo F. Smith.** Chairman, Educational Research Office, and Director of Counseling Center, Rochester Institute of Technology, Rochester, N Y. Co-author of *How to Read in Science and Technology.*

**L. F. Sl.—Lyndon Frederick Small.** Scientist Director, National Institute of Health, Washington, D C. Author of *Chemistry of the Opium Alkaloids.*

**L. F. Sr.—Laurance F. Shaffer.** Head of the Department of Guidance, Teachers College, Columbia University, New York, N.Y. Author of *The Psychology of Adjustment.*

**L. F. Sz.—L. F. Szilagyi.** Managing Director, Messrs. Siemens-Schukert (Great Britain), Ltd.

**L. F. V.-H.—Leveson Francis Vernon-Harcourt.** Professor of Civil Engineering, University College, University of London 1882–1905. Author of *Rivers and Canals; Harbours and Docks;* etc.

**L. G.—Linda Gardiner.** Secretary of the Royal Society for Protection of Birds, 1900–35. Former Editor of *Bird Notes and News.*

**L. G. B.—Lottie Genevieve Bishop.** Executive Secretary in the University Secretary's Office and in the School of Medicine, Yale University.

**L. G. C. L.—L. G. Carr Laughton.** Author of *Old Ship Figureheads and Sterns.*

**L. G. N.—Leo George Nunes.** Board of Governors, Amateur Fencers League of America. Chairman, Fencing Committee, New York Athletic Club, New York, N Y.

**L. G. R.—Leander Gaspard Roussin.** Former British delegate on the International Financial Commission, Athens, Greece.

**L. Gs.—Leo Gross.** Professor of International Law, Fletcher School of Law and Diplomacy, Medford, Mass. Author of *Pazifismus und Imperialismus.*

**L. Gu.—Luther Halsey Gulick.** President, Institute of Public Administration, New York, N.Y. Executive Director, Mayor's Committee on Management Survey of the City of New York. Author of *Education for American Life.*

**L. H.—Lewis Hodous, D.D.** Head of the Chinese Department of the Kennedy School of Missions, Hartford Seminary Foundation, Hartford, Conn., 1917–45. Professor, History and Philosophy of Religion, Hartford Theological Seminary, 1928–41. Former President of Foochow Theological Seminary.

**L. Ha.—Louis Halphen.** Professor of History, École des Hautes Études at the Sorbonne, Paris, 1928– .

**L. H. Ba.—Liberty Hyde Bailey.** Director, Bailey Hortorium, and Dean of College of Agriculture. Cornell University, 1903–13. Editor, *Standard Cyclopedia of Horticulture.*

**L. Hd.—Leland Howard.** Acting Director. United States Mint Service, Washington, D.C.

**L. H. D. B.—L. H. Dudley Buxton.** Former Reader in Physical Anthropology in Oxford University. Author of *Peoples of Asia.*

L. H. H.—**Libbie Henrietta Hyman.** Research Associate, Department of Invertebrates, The American Museum of Natural History, New York, N Y Author of *The Invertebrates: Protozoa Through Ctenophora; Comparative Vertebrate Anatomy.*

L. H. L.—**Lewis Harper Leech.** Columnist and editorial writer on *Chicago Daily News,* 1937–51.

L. Hn.—**Leon Henderson.** Chief Economist, Research Institute of America Former Administrator, Office of Price Administration, Washington, D C

L. H. R.—**Lloyd H. Reyerson.** Professor of Chemistry and Assistant Dean of the Institute of Technology, University of Minnesota, Minneapolis, Minn.

L. J.—**Sir Louis (Charles) Jackson.** Major General Assistant Director of Fortifications and Works, War Office, 1907–10, reappointed, 1914–46

L. J. B.—**Lawrence Johnston Burpee.** Former Secretary for Canada, International Joint Commission Author of *Bibliography of Canadian Fiction.*

L. J. C.—**Leslie John Comrie.** Superintendent of H M Nautical Almanac Office, Royal Naval College, Greenwich, 1930–36.

L. J. Ce.—**Leon Jacob Cole.** Professor of Genetics, University of Wisconsin, Madison, Wis, 1918–47.

L. J. D. R.—**Leopold John Dixon Richardson.** Professor of Greek, University College of South Wales and Monmouthshire, Cardiff, Wales.

L. J. K.—**Loyd J. Kiernan.** Manager, Special Studies, Public Relations Department, Association of American Railroads.

L. J. L.—**Lawrence J. Linck.** Executive Director, National Society for Crippled Children and Adults, Inc.

L. J. N.—**L. J. Norton.** Professor of Agricultural Economics and Chief in Marketing, Agricultural Experiment Station, University of Illinois, Urbana, Ill., 1936–

L. J. P.—**Louise Jenison Peet.** Professor and Head of Department of Household Equipment, Iowa State College, Ames, Ia.

L. J. S.—**Leonard James Spencer.** Editor, *Mineralogical Magazine,* 1900– , and [illegible] Keeper of Mineralogy, British Museum (Natural History), London, 1927–35. President of the Mineralogical Society, 1936–39. Author of *The World's Minerals;* etc.

L. J. T.—**L. J. Trinterud.** Professor of Church History, McCormick Theological Seminary, Chicago, Ill. Author of *The Forming of an American Tradition.*

L. J. V.—**Lee J. Vance.** Publisher of the *Beverage News.*

L. K.—**Lawrence Kolb, M.D.** Director, Medical Department, California Department of Mental Hygiene, 1945– . Assistant Surgeon-General and Chief, Division of Mental Hygiene, U.S. Public Health Service, 1938–44.

L. Ka.—**Leo Karpen.** President, S. Karpen and Bros., Chicago, Ill.

L. K. B.—**Lester K. Born.** Co-ordinator of Microreproduction Projects, Library of Congress, Washington, D C Secretary-General, International Council on Archives. Author of *Erasmus: The Education of a Christian Prince.*

L. K. D.—**Louis Klein Diamond, M.D.** Associate Professor of Pediatrics, Harvard Medical School Physician and Haematologist, Children's Medical Center Director, Haematology Research Laboratory, and Director, Blood Grouping Laboratory, Children's Hospital, Boston, Mass.

L. K. Fk.— **Lawrence K. Frank.** Former Director, Caroline Zachry Institute of Human Development, New York, N.Y. Author of *Nature and Human Nature; Projective Methods; Society as the Patient; Understanding Children's Play.*

L. K. J.—**Lee K. Jaffe.** Director of Public Relations, Port of New York Authority.

L. K. S.—**Lewis Ketcham Sillcox.** Executive Vice-President, New York Air Brake Company, Watertown, N Y. Author of *Mastering Momentum.*

L. L.—**Libero Lenti.** Professor of Statistics at Pavia University, Pavia, It. Contributor on Economics to *Corriere della Sera,* Milan, It Author of *Analisi di statistica economica; Statistica economica.*

L. Len.—**Leo Lentelli.** Sculptor Member, National Sculptors Society Member, Architectural League of New York. Associate of the National Academy Studio, New York, N.Y.

L. Li.—**L. Liegler.** Author of *Karl Kraus und sein Werk.*

L. Lip.—**Leslie Lipson.** Professor of Political Science and Public Administration, Victoria University College, University of New Zealand, Wellington, N Z Author of *The American Governor: From Figurehead to Leader; Politics of Equality: New Zealand's Adventures in Democracy.*

L. L. L.—**Lewis L. Lorwin.** Economic Adviser, Office of International Trade, United States Department of Commerce, 1945– . Author of *Post-War Plans of the United Nations;* etc

L. L. Ms.—**Lynn L. Means.** Meteorologist, United States Weather Bureau, Chicago, Ill. Author of *The Nocturnal Maximum Occurrence of Thunderstorms in the Midwestern States.*

L. Lo.—**Laurence Lockhart.** Orientalist. Author of *Nadir Shah; Famous Cities of Iran.*

L. L. W.—**Lorande Loss Woodruff.** Colgate Professor of Protozoology, 1922–47, and former Director of the Osborn Zoological Laboratory, Yale University.

L. M.—**Laurence Montague.** Sports Editor, the *Manchester Guardian.*

L. M. B.—**L. M. Buchanan.** Member of the Sudan Political Service.

L. McB. B.—**Liliana McBurney Brisby.** Author of *Les relations russo-bulgares, 1878–1886.*

L. Me.—**Leila Mechlin.** Editor, the *American Magazine of Art,* 1909–31.

L. M. F.—**Leonard M. Fanning.** Director of Public Relations, Victor A. Bennett Co., New York, N Y. Author of *American Oil Operations Abroad; The Rise of American Oil.*

L. M. G.—**Lawrence Murray Graves.** Professor of Mathematics, The University of Chicago. Vice-President, American Mathematical Society, 1943–44.

L. M. Gh.—**Leland M. Goodrich.** Professor of International Organization and Administration, Columbia University, New York, N Y Co-author of *Charter of the United Nations: Commentary and Documents.*

L. M. M.—**Louis Melville Massey.** Professor of Plant Pathology and Head of Department, Cornell University, Ithaca, N Y

L. M. P.—**Lillian Margery Penson.** Professor of Modern History, Bedford College, [illegible] London. Author of *The Colonial Agents of the British West Indies*

L. M-Po.—**Lorenzo Minio-Paluello.** Senior Lecturer in Mediaeval Philosophy, Oxford University. Author of critical editions of Aristotle's *Categoriae* and *De Interpretatione;* critical edition of the Latin translation of Plato's *Phaedo* by Aristippis.

L. Ms.—**Leonor Michaelis.** Former Member, the Rockefeller Institute for Medical Research, New York, N Y Former Member, National Academy of Science. Author of *Hydrogen Ion Concentration; Oxidation-Reduction Potentials.*

L. M. T.—**Leonard Monteath Thomson.** Senior Lecturer in History, University of Cape Town, Cape Town, U. of S. Af. Author of *The Cape Coloured Franchise.*

L. Mu.—**Lewis Mumford.** Member of Executive Committee, Regional Planning Association of America. Author of *The Golden Day;* etc.

L. N. R.—**Louis Nicot Ridenour, Jr.** Dean of the Graduate School, University of Illinois, Urbana, Ill, 1947– . Professor of Physics, University of Pennsylvania, Philadelphia, 1946–47.

L. O. B.—**Lawrence Olin Brockway.** Professor of Chemistry, University of Michigan, Ann Arbor, Mich.

L. of F.—**Arthur Hamilton Lee, 1st Viscount Lee of Fareham.** Chairman of the Board of Governors, Sulgrave Manor, Northamptonshire, England, 1925–27.

L. O. H.—**Leland Ossian Howard.** Principal Entomologist, U S. Department of Agriculture, Bureau of Entomology, Washington, D C., 1927–31.

Lo. L.—**Leo Loewenson.** Deputy Librarian and Tutor in Russian History, School of Slavonic Studies, University of London.

L. Or.—**Louise Overacker.** Professor of Political Science, Wellesley College, Wellesley, Mass. Author of *The Presidential Primary.*

L. P.—**Louise Pound.** Professor of English Literature, University of Nebraska, Lincoln, Neb, 1912–45.

L. P. A.—**Leonard Porter Ayres.** Former Vice-President, The Cleveland Trust Company, Cleveland, O. Author of *Seven* [illegible], etc.

L. P. E.—**Luther Pfahler Eisenhart.** Dean of the Graduate School, Princeton University, 1933–45. Editor of *Annals of Mathematics.* Author of *Differential Geometry of Curves and Surfaces.*

L. P. S.—**Lybrand P. Smith, Jr.**

L. R. D.—**Lawrence Robert Dicksee.** Former Head of Sellars, Dicksee & Co. Sir Ernest Cassel Professor of Accountancy and Business Organization in the University of London, 1919–26.

L. R. Dt.—**Lester R. Dragstedt, M.D.** Professor and Chairman of the Department of Surgery, The University of Chicago.

L. R. F.—**Lewis Richard Farnell.** Vice-Chancellor, Oxford University, 1920–23. Former University Lecturer in Classical Archaeology; and Wilde Lecturer in Comparative Religion. Author of *Cults of Greek States: Evolution of Religion;* etc.

**L. R. Fd.—Lester R. Ford.** Professor of Mathematics, Illinois Institute of Technology, Chicago, Ill Former President, Mathematical Association of America. Author of *Automorphic Functions; Differential Equations; Alignment Charts.*

**L. Ri.—Louis Ripault.** Private Secretary to the President of the Chamber of Deputies, Paris, France. Author of *Histoire du Canada.*

**L. R. L.—Lenox Riley Lohr.** President, Museum of Science and Industry, Chicago, Ill. Author of *Fair Management; Magazine Publishing; Television Broadcasting.*

**L. R. Ma.—L. R. Marti.** Head, Men's Physical Education, University of North Dakota, Grand Forks, N D.

**L. Ro.—Lennox Robinson.** Manager of the Abbey Theatre, Dublin, 1910–14, 1919–23. Director, Abbey Theatre, 1923.

**L. Rs.—Laszlo Rostas.** Research Statistician, Board of Trade, London. Former Research Associate, National Institute of Economic and Social Research, London Author of *Productivity, Prices and Distribution in Selected British Industries;* etc.

**L. R. T.—L. Reed Tripp.** Lecturer in Economics, University of Wisconsin, Madison, Wis

**L. R. W.—Leonidas Rutledge Whipple.** Professor of Journalism, New York University, New York, N.Y., 1930–46. Author of *The Story of Civil Liberty in the United States;* etc.

**L. S.—Sir Leslie Stephen.** English biographer and literary critic Editor, *Dictionary of National Biography,* 1882–91.

**L. S. B.—Lawrence Sabin Brodie.** Senior Scientific Officer in Royal Naval Scientific Service.

**L. S. Bd.—Lawrence S. Brodd.** Office Engineer, Portland Cement Association.

**L. Sc.—Rt. Hon. Sir Leslie (Frederic) Scott.** Lord Justice of Appeal, 1935–48. Represented His Majesty's Government at International Conferences on Maritime Law, Brussels, 1909, 1910, 1922 and 1926.

**L. S. C.—Lee S. Crandall.** General Curator, Mammals and Birds, New York Zoological Park, New York, N.Y. Author of *Pets: Their History and Care* and *Paradise Quest.*

**L. Sco.—Lester Scott.** Of the Sports Department, *New York World-Telegram,* New York, N.Y.

**L. S. D.—Louis Serle Dederick.** Head Mathematician, Aberdeen Proving Ground, Aberdeen, Md

**L. S. H.—Leta S. Hollingworth.** Former Professor of Education, Teachers College, Columbia University. Author of *Psychology of Subnormal Children; Children above 180 I. Q., Stanford-Binet: Origin and Development; Psychology of the Adolescent;* etc.

**L. Si.—Lee Simonson.** Director of Theatre Guild, Inc. New York, N.Y., 1919–40. Former Editor, *Creative Art.* Author of *The Stage is Set; Theatre Art; Part of a Lifetime: Drawings and Designs, 1919–1940.*

**L. Sk.—Louis Skidmore.** Chief of Design, A Century of Progress Exposition, Chicago, Ill., 1933–34. Consultant for New York World's Fair, 1939.

**L. S. K.—Lawrence Schlesinger Kubie, M.D.** Associate in Neurology, College of Physicians and Surgeons, Columbia University, New York, N.Y. Faculty, New York Psychoanalytic Institute, New York. Author of *Practical Aspects of Psychoanalysis.*

**L. S. Kl.—Louis S. Kassel.** Assistant Executive Vice-President, Universal Oil Products Company, Chicago, Ill Author of *Kinetics of Homogeneous Gas Reactions.*

**L. Sl.—Leverett Saltonstall.** U S Senator, 1945– , Governor of Massachusetts, 1939–45. Overseer of Harvard University

**L. S. Ma.—Lionel Simeon Marks.** Emeritus Professor of Mechanical Engineering, Harvard University Editor in Chief of *Mechanical Engineers' Handbook.* Author of *The Airplane Engine;* etc.

**L. Sn.—Ludwik Silberstein.** Mathematical Physicist, Research Laboratory, Eastman Kodak Co, Rochester, N.Y, 1920–29. Author of *Vectorial Mechanics;* etc

**L. S. O'M.—L. S. O'Malley.** Author of *History of Bengal; Bihar and Orissa Under British Rule;* etc

**L. S. R.—Leo S. Richardson.** Assistant to the Chief, Section of Information, Bureau of Dairy Industry, U.S. Department of Agriculture

**L. S. Rl.—Lewis S. Ramsdell.** Professor and Chairman of the Department of Mineralogy, University of Michigan, Ann Arbor, Mich. Co-author of *Mineralogy.*

**L. S. Ro.—Leo S. Rowe.** Former Director General, Pan American Union, Washington, D C. Co-author of *Report of the United States Commission to Revise the Laws of Porto Rico;* etc. Author of *The United States and Porto Rico;* etc.

**L. S. S.—L. Susan Stebbing.** Professor of Philosophy in the University of London, 1933–43.

**L. S. Sd.—Lucy Stuart Sutherland.** Principal of Lady Margaret Hall, Oxford Author of *A London Merchant, 1695–1774; The East India Company in Eighteenth Century Politics.*

**L. St.—Leonard Stein.** President, Anglo-Jewish Association. Author of *Zionism.*

**L. T.—Lorado Taft.** Sculptor Author of *History of American Sculpture;* etc.

**L. T. A.—Lyle Thomas Alexander.** Soil Scientist, U.S. Department of Agriculture, Washington, D.C.

**L. T. Co.—Lowell T. Coggeshall, M.D.** Dean, Division of Biological Sciences, The University of Chicago.

**L. T. E.—Leon Theodore Eliel.** Vice-President, Fairchild Aerial Surveys, Inc, Los Angeles, Calif.

**L. T. G.—Laura T. Griggs.** Wife of Robert F. Griggs, the discoverer of the Valley of Ten Thousand Smokes and Author of *The Valley of Ten Thousand Smokes.*

**L. T. H.—Lancelot T. Hogben.** Professor of Medical Statistics, 1947– , Mason Professor of Zoology, 1942–47, University of Birmingham, England. Regius Professor of Natural History, University of Aberdeen, Scotland, 1937–41. Author of *The Nature of Living Matter;* etc.

**L. T. Ho.—Leonard T. Hobhouse.** Former Professor of Sociology, University of London.

**L. Tr.—Lev Trotsky.** Former Head of the Central Committee for Concessions, Union of Soviet Republics, and People's Commissar for Foreign Affairs, and Commissar for War, Moscow, U.S.S.R.

**L. Ts.—Lorie Tarshis.** Professor of Economics, Stanford University, Stanford, Calif. Co-author of *Elements of Economics: Mobilizing Resources for War.*

**L. T. Se.—Lucy Taxis Shoe.** Associate Professor of Art and Archaeology, Mount Holyoke College, South Hadley, Mass. Author of *Profiles of Greek Mouldings.*

**L. Tu.—Louis Tuft, M.D.** Assistant Professor of Medicine, Temple University School of Medicine, Philadelphia, Pa Chief of Allergy Clinic, [illegible] Hospital, Philadelphia, Pa Author of *Clinical Allergy; Clinical Immunology, Biotherapy and Chemotherapy.*

**Lu.—Frederick Dealtry Lugard, 1st Baron Lugard of Abinger.** British Member of Permanent Mandates Commission, League of Nations, 1922–36 Commander of Legion of Honour, 1917 Author of *The Dual Mandate in British Tropical Africa;* etc.

**L. U.—Lyndall Urwick.** Lieutenant-Colonel, Petroleum Warfare Department, 1942–44. Consultant to H M. Treasury, 1940–42. Co-author of *Factory Organization;* etc.

**L. Un.—Louis Untermeyer.** Author, critic and editor Editor of *Modern American Poetry, Modern British Poetry;* etc Author of *American Poetry since 1900;* etc.

**L. V.—Luigi Villari.** Official in the Royal Italian Foreign Office (retired) Author of *Italian Life in Town and Country;* etc.

**L. V. F.—Leon V. Foster.** Chief Microscope Engineer, Bausch & Lomb Optical Co., Rochester, N.Y.

**L. V. H.—Lewis Victor Heilbrunn.** Professor of Zoology, University of Pennsylvania, Philadelphia, Pa Author of *The Colloid Chemistry of Protoplasm;* etc.

**L. V. J.—Lewis Van Hagen Judson.** Chief, Length Section and Senior Physicist, Division of Weights and Measures, National Bureau of Standards. Author, *Testing of Line Standards of Length*

**L. von M.—Ludwig von Mises.** Visiting Professor, Graduate School of Business Administration, New York University. Author of *Socialism;* etc.

**L. V. P.—Ludwig von Pastor.** Former Professor of History in the University of Innsbruck, Austria, and Director of the Austrian Institute of Historical Studies in Rome.

**L. V. Po.—Leroy V. Porter.** Former Assistant Vice-President and Comptroller, New York Central System.

**L. W.—Lucien Wolf.** Former President of the Jewish Historical Society of England. Author of *Diplomatic History of the Jewish Question.*

**L. Wa.—Lina Waterfield.** Foreign Correspondent of the Kemsley Press, 1946– . Author of *Home Life in Italy; The Story of Rome;* etc.

**L. W. B.—Lewis Warrington Baldwin.** Former President, Member of Executive Committee and Chief Executive Officer, Missouri Pacific Railway Company.

**L. W. Be.—Lewis W. Bealer.** Berkeley, California Former Assistant Professor of History, University of Oklahoma, Norman, Okla.

**L. W. D.—Leon W. Dean.** Assistant Professor of English and Vermont History, University of Vermont, Burlington, Vt.

**L. W. F.—Lionel Wray Fox.** Chairman, Prison Commission for England and Wales. Author of *The Modern English Prison.*

**L. W. H.—Lawrence Whitaker Harrison.** Colonel. Former Special Medical Officer (Venereal Disease), Ministry of Health, London Editor, 1925–42, *British Journal of Venereal Diseases.*

**L. W. Hg.—Lowry W. Harding.** Professor of Education, Ohio State University, Columbus, O Author of *Anthology in Educology, Functional Arithmetic Photographic Interpretations; Student Teaching in the Elementary School*

**L. W. Hu.—Leroy W. Hutchins.** Writer on outdoor sports

**L. Wi.—Louis Wiley.** Business Manager, *The New York Times,* 1906–35

**L. W. J.—Lloyd W. Josselyn.** Librarian, Albert A Wells Memorial Library, Lafayette, Ind

**L. W. Ms.—Lloyd W. Mints.** Associate Professor of Economics, The University of Chicago.

**L. Wr.—Laurence Wray.** Editor, *Electrical Merchandising* Author of *Electrical Appliance Sales Handbook*

**L. Ws.—Lou Williams.** Instructor in Geology, The University of Chicago. Author of *A Dipper Full of Stars*

**L. W. S.—Louis Wendlin Sauer, M.D.** Assistant Professor of Pediatrics, Northwestern University Medical School, Chicago, Ill. Author of *Nursery Guide; From Infancy Through Childhood.*

**L. W. Sh.—Leo W. Stach.** Technical Consultant, Petroleum and Natural Gas, Tokyo, Japan.

**L. W. T.—Lloyd William Taylor.** Head of Department of Physics, Oberlin College, Oberlin, O 1924–48. Author of *Fundamental Physics;* etc

**L. W. V.-H.—L. W. Vernon-Harcourt.** Author of *His Grace the Steward and the Trial of Peers.*

**Lz.—Count Lutzow.** Author of *The Life and Times of Master John Hus;* etc

**M.—Thomas Babington Macaulay,** 1st Baron Macaulay of Rothley. English statesman, essayist and historian. Author of *The History of England;* etc

**M. A.—Mary Hunter Austin.** Author and former lecturer at Yale University. Translator of American Indian poetry. Author of *The Basket Woman;* etc.

**M. A. B.—M. A. Blankenhorn, M.D.** Director, Department of Internal Medicine, Cincinnati General Hospital Professor of Medicine, University of Cincinnati, Cincinnati, O.

**Ma. Bg.—Baroness Maura Budberg.** Story Editor, London Films, London.

**M. A. C.—Morse Adams Cartwright.** Professor of Education and Executive Officer, Institute of Adult Education, Columbia University.

**M. A. F.—Mildred Adams Fenton.** Co-author of *The Rock Book; Story of the Great Geologists.*

**Ma. G.—Marija Gimbutas.** Archaeologist of East Europe and Siberia, Peabody Museum. Research Fellow, Harvard University.

**M. A. H.—Mary Agnes Hamilton.** Retired British Civil Servant. Editor, *English-Speaking World.* Author of *Life of Arthur Henderson; Sidney and Beatrice Webb.*

**M. A. Hn.—M. A. Hein.** Senior Agronomist, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture.

**M. A. J.—Morley Allan Jull.** Professor of Poultry Husbandry and Head of the Department, University of Maryland, College Park, Md Author of *Poultry Husbandry* and *Successful Poultry Management.*

**M. A. L.—Morris Albert Linton.** President, Provident Mutual Life Insurance Company of Philadelphia, Pa Former President, Actuarial Society of America

**M. A. M.—Margaret Alice Murray.** Former Assistant Professor of Egyptology, University of London Author of *Witch Cult in Western Europe;* etc.

**M. A. Ml.—Max A. Michael.** Office of Public Relations, U S Department of the Navy, Washington, D C

**Ma. S.—Maurice Saunders.** Chairman of the Board of Directors, the Lithographers National Association Inc.

**Ma. Si.—Marcel Simon.** Professor and Dean of the Faculty of Arts and former Lecturer in Alsatian History University of Strasbourg, Strasbourg, France Author of *Verus Israel: Etude sur les relations entre Chrétiens et Juifs dans l'empire romain; Vues Générales sur l'histoire de l'Alsace.*

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**M. A. Wa.—Mary A. Ward (Mrs. Humphry Ward).** Author of *Robert Elsmere;* etc, and contributor to *Dictionary of Christian Biography.*

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**R. G. H.—Ralph George Hawtrey.** Assistant Secretary to the Treasury, London. Author of *Currency and Credit;* etc.

**R. G. Hu.—Ray Garland Hulburt.** Director of Information and Statistics, American Osteopathic Association, 1924–47. Former Editor of *The Journal of the American Osteopathic Association*

**R. Gi.—Sir Robert Giffen.** Former Assistant Editor, with Walter Bagehot, of the *Economist.* [illegible] (1892–97) to the British [illegible] Author of *Essays on Finance;* etc.

**R. Git.—Roy Gittinger.** Regents' Professor of History, 1946– . Dean of Administration, 1926–41, Dean of Admission, 1941–46, University of Oklahoma, Norman, Okla. Author of *The Formation of the State of Oklahoma;* etc.

**R. Gl.—Ralf Gall.** Former Assistant Financial Editor, *Chicago Daily News.*

**R. G. O.—Ralph G. Owens.** Dean of Engineering, [illegible] of Technology, Chicago, Ill.

**R. G. P.—Ralph G. Peterson.** Public Relations Consultant.

**R. G. Rr.—Robert George Raymer.** Former Associate Professor of History, University of Redlands, Redlands, Calif. Author of *Montana, the Land and the People.*

**R. G. S.—Robert Gordon Sproul.** President, University of California, Berkeley, Calif.

**R. G. Se.—Robert Granville Stone.** Meteorologist, Headquarters, Air Weather Service (A A F) Editor, *Bulletin of the American Meteorological Society.* Author of *Meteorology of the Virgin Islands;* etc.

**R. G. Sr.—Ralph G. Sanger.** Professor and Head of the Department of Mathematics, Kansas State College, Manhattan, Kansas. Author of *Synthetic Projective Geometry*

**R. Gt.—Raleigh Gilchrist.** Senior Chemist, National Bureau of Standards, U.S Department of Commerce, Washington, D.C.

**R. H. Bt.—Ralph Henry Bassett.** Retired Permanent Secretary, Ministry of Industries and Fisheries, Ceylon Government Author of *The Rare Romances of Nari ya the Jackal, Romantic Ceylon.*

**R. H. C.—Sir Reginald Henry Craddock.** Member of the Royal Commission on the Civil Services of India, 1923–24. Lieutenant-Governor of Burma, 1917–22.

**R. H. Ch.—Robert Henry Charles, D.D.** Former Archdeacon of Westminster Former Fellow of Merton College, Grinfield Lecturer and Lecturer in Biblical Studies, Oxford. Author of *Lectures on the Apocalypse; Studies in the Apocalypse;* etc.

**R. H. D.—Sir Robert H. Davis.** Governing Director of Siebe, Gorman & Co., Ltd, submarine engineers, London Author of *Deep Diving and Submarine Operations;* etc.

**R. He.—Richard Hesse.** Professor of Zoology and Director Zoological Institute in the University of Berlin, 1926–36.

**R. H. E.—Robert H. Ebert, M.D.** Chief of Division of Pulmonary Diseases, Billings Hospital, The University of Chicago.

**R. H. Fe.—Ralph Holmes Ferguson.** In charge of the Physical Chemical Research Laboratory, Procter and Gamble Co.

**R. H. Fg.—Richard Howell Fleming.** Assistant Prof[illegible] of Oceanography, Scripps Institute of [illegible] a, Calif Co-author of *The Oceans; Their Physics, Chemistry, and General Biology.*

**R. H. Ga.—Ralph Henry Gabriel.** Professor of History, Yale University. Author of *The Evolution of Long Island;* etc Editor, *Christianity and Modern Thought;* etc.

**R. H. Gr.—R. H. Gretton.** Lecturer in Modern History, Oxford University.

**R. H. L.—Robin Humphrey Legge.** Music Critic for *The Daily Telegraph,* London, 1908–31. Author of *Annals of the Norwich Festivals;* etc

**R. H. Le.—Richard Henry Leigh.** Admiral, United States Navy. Former Chief of Bureau of Navigation, Washington, D.C.; Commander in Chief, U.S. Fleet.

**R. H. Lo.—Robert Harry Lowie.** Professor of Anthropology, University of California, Berkeley, Calif. Former President, American Anthropological Association. Author of *Introduction to Cultural Anthropology; The History of Ethnological Theory;* etc.

**R. H. Mr.—Ralph Hermon Major, M.D.** Professor of Medicine, University of Kansas School of Medicine, Kansas City, Kan. Author of *Physical Diagnosis and Classic Descriptions of Disease.*

**Rh. P.—Ralph Pemberton, M.D.** Professor of Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia, Pa Author of *Arthritis and Rheumatoid Conditions;* co-author of *Medical and Orthopaedic Management of Chronic Arthritis.*

**R. H. P.—Rupert Howard Porter.** Seed Technologist, American International Association, Rio de Janeiro, Brazil, 1947– . Professor of Botany, Research Professor of Agronomy and Director of Seed Laboratory, Iowa State College, Ames, Iowa, 1932–46.

**R. H. Q.—Rev. Robert Hebert Quick.** Former Lecturer on Education, Cambridge University. Author of *Essays on Educational Reformers.*

**R. H. R.—Sir (R.) Henry Rew.** Chairman, Inter-[illegible] Committee on Unemployment Insurance in Agriculture, 1925–26. Board of Agriculture and Fisheries, 1898, Assistant Secretary, 1906–18. Secretary to the Ministry of Food, 1916–17 -Author of *A Primer of Agricultural Economics;* etc

**R. H. Ra.—Robert Heron Rastall.** Attached to War Office, 1915–19 Author of *Geology of the Metalliferous Deposits; Physico-Chemical Geology* Co-author of *Textbook of Geology and Petrology of Sedimentary Rocks;* etc Former Editor of the *Geological Magazine.*

**R. H. Rn.—Robert Henry Ralston.** Research Chemist, Hercules Powder Co, Wilmington, Del

**R. H. Rs.—Ray Harland Roberts.** Professor of Horticulture, University of Wisconsin, Madison, Wis

**R. H. S.—Richard Haviland Smythe.** Architect.

**Rh. S. C.—Ruth Shonle Cavan.** Associate Professor of Sociology, Rockford College, Rockford, Ill. Author of *American Family; Criminology; Suicide.*

**R. H. Sh.—Robert Hale Shields.** Assistant in History, University of California, Berkeley, Calif

**R. Hu.—Sir Robert Hunter.** Author of *The Preservation of Open Spaces and of Footpaths and Other Rights of Way.*

**R. H. W.—Robert Hendry Weir.** Assistant Director, Directorate of Engine Research and Development, Ministry of Supply, London

**R. H. Y.—Richard Hugh Young.** Assistant Public Relations Adviser, Development and Welfare Organization in the West Indies

**R. I.—Roger Ingpen.** Editor of *Letters of [illegible] Shelley; A Selection of Shelley's [illegible] Regent Library.* Co-editor of Julian Edition of Shelley's complete works.

**R. I. P.—Reginald Innes Pocock.** Temporary Assistant in the Zoological Department of the British Museum, London, 1923–47, and former Natural History Editor of *The Field.* Author of *Arachnida of British India and Mammalia of British India,* Vol. I, II.

**R. I. T.—Robert I. Tenney.** President, Wahl-Henius Institute, Chicago, Ill.

**R. Ja.—Roland Godfrey Janson.** New York, N.Y.

**R. J. Be.—Ralph J. Bunche.** Director, Department of Trusteeship and Information from Non-Self-Governing Territories, United Nations; Acting U.N. Mediator on Palestine, 1948–49. Nobel Prize for Peace, 1950.

**R. J. C.—Robert Jesse Charleston.** Assistant Keeper, Department of Ceramics, Victoria and Albert Museum, London.

**R. J. C. A.—Richard John Copland Atkinson.** Lecturer in Prehistoric Archaeology, University of Edinburgh. Edinburgh, Scot. Author of *Field Archaeology.*

**R. J. G.—Reginald John Gladstone, M.D.** Former Reader in Anatomy and Lecturer in Embryology, King's College, University of London.

**R. J. H. K.—Robert John Herman Kiphuth.** Professor of Physical Education and Head Coach of Swimming, Yale University, New Haven, Conn. United States Olympic Coach, 1928, 1932, 1936, 1940, 1948. Author of *Swimming;* co-author of *Basic Swimming*

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**R. J. K.—Raymond John Kelly.** National Commander, The American Legion, 1939–40

**R. J. Mi.—R. J. Milbourne.** Member of the Council and Chairman (1928–29) of the Society of British Gas Industries Author of *Gasholder Design and Construction*

**R. J. Mr.—Robert J. Maurer.** Associate Professor of Physics, Carnegie Institute of Technology, Pittsburgh, Pa.

**R. Jn.—Raymond Johnson.** Sports Editor, *The Nashville Tennessean,* Nashville, Tenn President, Amateur Softball Association of America.

**R. J. Sn.—R. J. Stephenson.** Professor and Head of the Department of Physics, College of Wooster, [illegible] Author of *Exploring in Physics; Mechanics and Properties of Matter.*

**R. J. T.—Richard John Tabor.** Retired Assistant Professor of Botany, Imperial College of Science and Technology, University of London.

**R. J. Tr.—Robert Julius Trumpler.** Professor of Astronomy, University of California, Berkeley, Calif.

**R. K.—Rollin Kirby.** Former Cartoonist, *Look Magazine* Political Cartoonist, the *New York Post,* 1939–42.

**R. K. B.—Ralph Klaus Blumenau.** Assistant Master at the King's School, Canterbury, Eng.

**R. K. D.—Sir Robert Kennaway Douglas.** Former Keeper of Oriental Printed Books and MSS. at the British Museum, London, and Professor of Chinese, King's College, London. Author of *The Language and Literature of China;* etc.

**R. Ke.—Rudolf Kingslake.** Head of Optical Design Department, Eastman Kodak Co., Rochester, N.Y.

**R. K. E.—Richard Kempton Estelow.** Research Chemist, Columbian Carbon Company, Brooklyn, N.Y.

**R. K. G.—Ralph Kalb Ghormley, M.D.** Professor in Orthopaedic Surgery, Mayo Foundation, and Head of Orthopaedic Section, Mayo Clinic, Rochester, Minn. Co-author of *Diagnosis in Joint Disease.*

**R. L. A.—Sir Reginald Laurence Antrobus.** Member of Central Board of Finance of Church of England, 1925–35, and National Assembly, 1920–25. Governor of St. Helena, 1889–90.

**R. L. Be.—Richard L. Beyer.** Department of History, State University of Iowa, Iowa City, Ia.

**R. Ld.—Robert Lynd.** Formerly on staff of the *News Chronicle,* London. Author of *Books and Authors;* etc.

**R. L. E.—Richard L. Evans.** Editor, writer, church official. Author of *At This Same Hour; The Spoken Word; This Day and Always; Tonic for Our Times; Unto the Hills.*

**R. Lev.—Reuben Levy.** Lecturer in Persian, Cambridge University.

**R. L. F.—Rachel Louise Fitch.** Dean of Women, Cornell University, Ithaca, N.Y., 1926–41.

**R. L. H.—Richard Lionel Hippisley.** Colonel. Formerly employed in the Trigonometrical Survey of Cyprus. Deputy Director, Army Signals, Central Force, 1914–16.

**R. L. Ha.—Robert Lee Hale.** Professor of Law, Columbia University. Author of *Valuation and Rate Making;* etc.

**R. L. Ho.—Robert Lockhart Hobson.** Former Keeper of Department of Oriental Antiquities and Ethnography, British Museum, London. Author of *Worcester Porcelain, Chinese Pottery and Porcelain,* etc

**R. L. Ht.—R. L. Hallett.** Former Chief Chemist, National Lead Company, New York, N.Y Author of Paint Industry Section of *Representative Industries in the United States;* etc

**R. L. M.—Rodolphe Louis Mégroz.** Author of *Gabriel Rosetti; Profile Art Through the Ages.*

**R. L. Ne.—R. L. Neyman.** Commander, U S Navy Bureau of Ordnance, U S Department of the Navy, Washington, D C

**Rl. P.—Raphael Powell.** Reader in Law, University of London. Author of *The Law of Agency;* etc.

**R. L. P.—Reginald Lane Poole.** Former Honorary Fellow of Magdalen College, Oxford. Lecturer in Diplomatics in the University, 1896–1927. Keeper of the University Archives, 1909–27. Curator of the Bodleian Library, 1914–26. Author of *Wycliffe and Movements for Reform.*

**R. L. Pn.—Robert L. Pendleton.** Principal Soil Technologist, Office of Foreign Agricultural Relations, U.S. Department of Agriculture, Washington, D C. 1942–

**R. L. S.—Robert Louis Stevenson.** Former novelist, essayist and poet. Author of *Kidnapped; Treasure Island;* etc.

**R. L. S.-R.—Reginald Leslie Smith-Rose.** Director, Radio Research, Department of Scientific and Industrial Research [illegible]

**R. L. T.—Ralph Lilley Turner.** Director, School of Oriental and African Studies; Professor of Sanskrit, University of London. Author of *Gujarati Phonology;* etc.

**R. L. Te.—Robert L. Thorndike.** Professor of Education, Teachers College, Columbia University, New York, N.Y. Author of *Personnel Selection.*

**R. L. W.—Ray Lyman Wilbur, M.D.** Former Chancellor of Stanford University, Stanford, Calif Former Secretary of the Interior, Washington, D C.

**R. L. Wi.—Raymond Louis Wilder.** Research Professor of Mathematics, University of Michigan, Ann Arbor, Mich. Former Research Worker, Institute for Advanced Study.

**R. L. Wl.—Rupert L. Wenzel.** Assistant Curator of Insects, Chicago Natural History Museum, Chicago, Ill.

**R. Ly.—Richard Lydekker.** Member of staff of Geological Survey of India, 1874–82. Author of *Catalogues of Fossil Mammals, Reptiles and Birds in British Museum;* etc.

**R. Ma.—Robert Mackintosh, D.D.** Professor at Lancashire Independent College and Lecturer in the University of Manchester, England, 1904–30 Author of *Essays Towards a New Theology; First Primer of Apologetics;* etc.

**R. M. A.—Rudolph M. Anderson.** Chief of Division of Biology, National Museum of Canada, Ottawa, 1920–46. Author of *Birds of Iowa.*

**R. MacD.—Robert MacDonald, Jr.** Vice-President and Director, General Abrasive Company, Inc, Niagara Falls, N.Y.

**R. M. B.—Richard Milton Bozorth.** Research Physicist, Bell Telephone Laboratories, Murray Hill, N.J.

**R. McK.—Roderick MacKenzie.** Former Fereday Fellow of St John's College, Oxford, and Assistant Editor of the 9th edition of Liddell and Scott's *Greek-English Lexicon.*

**R. M. F.—R. M. Fleming.** Librarian, The Geographical Association, Aberystwyth. Author of *Ancient Tales from Many Lands;* etc.

**R. M. Fo.—Raymond Michael Foley.** Former Administrator, Housing and Home Finance Agency, Washington, D C.

**R. M. H.—Ronald Martin Howe.** Deputy Commissioner of Police, Scotland Yard. Author of *Criminal Investigation, Adapted From Hans Gross.*

**R. M. He.—Robert Mitchell Henry.** Professor of Humanity, St Andrews University, Scotland Honorary Professor of Classical Literature, Trinity College, Dublin. Professor of Latin, 1907–38.

**R. M. Hu.—Rowland M. Hussey.** Superintendent, Wire Department, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

**R. M. J. L.—Robert Maurice Jean Lemoir.** Technical Director, Smith's English Clocks, Ltd., London.

**R. M. L.—Russell Mortimer Luckock.** Major General Commander, 54th Division, T A., 1934–38. Former Commandant, Small Arms Schools, India, and O.C. 163rd Infantry Brigade, Territorial Army, 1926–28 Brigadier, General Staff, Southern Command, Salisbury, 1928–32.

**R. M. Le.—Robert MacDonald Lester.** Secretary, Carnegie Corporation of New York, N.Y. Author of *Forty Years of Carnegie Giving;* etc.

**R. M. O.—Robert M. Ormerod.** Director of John Ormerod and Sons, Ltd., manufacturers of leather belting, etc.

**R. Mr.—Roland Émile Mousnier.** Professor of Modern History in the Faculty of Letters, University of Strasbourg, Strasbourg, Fr. Author of *La Vénalité des offices sous Henri IV et Louis XIII; Le XVIIIe Siècle, révolution intellectuelle, technique, politique.*

**R. M. R.—R. Marion Robb.** Research Group Leader, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

**R. M. T.—R. M. Tryon.** Chemical Warfare Development Laboratory of the Massachusetts Institute of Technology.

**R. Mu.—Ramsay Muir.** Former Lecturer in Modern History at Owens College, Manchester, England

**R. M. W.—Robert Mark Wenley.** Former Professor of Philosophy in the University of Michigan, Ann Arbor, Mich.

**R. M. Wn.—Richard Middlewood Wilson.** Head of the Department of English Language, University of Sheffield, Sheffield, Eng. Author of *Early Middle English Literature; The Lost Literature of Medieval England.*

**R. M. Wr.—Russell M. Wilder, M.D.** Director, National Institute of Arthritis and Metabolic Diseases, Bethesda, Md. Former Professor and Chief of the Department of Medicine, Mayo Foundation for Medical Education and Research, Rochester, Minn. Author of *Clinical Diabetes Mellitus and Hyperinsulinism; A Primer for Diabetic Patients.*

**R. My.—Raymond Massey.** Actor of the stage, screen and radio; director and producer in the theatre.

**R. N. B.—Robert Nisbet Bain.** Assistant Librarian, British Museum, London, 1883–1909. Author of *Scandinavia The Political History of Denmark, Norway and Sweden, 1513–1900, Slavonic Europe. The Political History of Poland and Russia from 1469 to 1796;* etc.

**R. N. Ba.—Robert Nesham Bax.** Admiral, R N (retired) Director of the Mobilization Department at the Admiralty, 1924–26. Naval A D C to the King, 1922–23

**R. N. C.—Ram Nath Chopra, M.D.** Director, Drug Research Laboratory, Jammu and Kashmir, India. Author of *Anthelmentics and Their Uses in Medical and Veterinary Practice; Indigenous Drugs of India; Poisonous Plants of India; Tropical Therapeutics.*

**R. Ne.—Ragnar Nurkse.** Professor of Economics, Columbia University, 1947– . Member, Economic, Financial and Transit Department League of Nations, 1934–45. Author of *Internationale Kapitalbewegungen.*

**R. N. L.—Richard N. Larkin.** Bureau Manager, *Business Week,* Pittsburgh, Pa.

**R. Nm.—Rodney Needham.** Research worker, Institute of Social Anthropology, Oxford University.

**R. N. R.-B.—R. N. Rudmose-Brown.** Emeritus Professor of Geography, University of Sheffield, England. Member of the Scottish National Antarctic Expedition 1902–04, and of the Scottish Arctic Expeditions 1909, 1914 and 1919 Author of *Spitsbergen.*

**R. N. S.—R. Norris Shreve.** Professor of Chemical Engineering, Purdue University, Lafayette, Ind Author of *Chemical Process Industries; Selected Process Industries; Dyes Classified by Intermediates;* etc.

**R. N. W.—Ralph Nicholson Wornum.** Keeper of the National Gallery, London, 1854–77 Author of *The Epochs of Painting;* etc.

**Ro. F.—Robert Ferber.** Research Associate Professor, Bureau of Economic and Business Research, Department of Economics, University of Illinois, Urbana, Ill Author of *Statistical Techniques in Market Research.*

**Ro. P. Be.—Roland P. Blake.** Principal Safety Engineer, United States Department of Labour. Author of *Industrial Safety*

**R. P.—René Poupardin.** Secretary of the École des Chartes; Honorary Librarian at the Bibliothèque Nationale, Paris.

**R. Pa.—Sir Richard Arthur Surtees Paget.** Assistant Secretary, Admiralty Board of Invention and Research, 1915–18.

**R. Par.—Raymond Parmer.** Of the firm of Kirlin, Campbell, Hickox and Keating, lawyers, New York, N.Y.

**R. P. B.—Rudolf P. Berle.** Former law secretary to the Justices of the Massachusetts Supreme Judicial Court.

**R. P. Br.—Ralph Paul Bieber.** Professor of History, Washington University, St Louis, Mo. Author of *The Lords of Trade and Plantations.*

**R. P. Bs.—Robert P. Brooks.** Dean of Faculties, 1945– , and Director, Institute of Public Affairs, University of Georgia, Athens, Ga. Author of *A History of Georgia; The Agrarian Revolution in Georgia.*

**R. P. C.—Robert Pierce Casey.** Professor and Head of Department of Biblical Literature and History of Religion, Brown University, Providence, R.I., 1934–50.

**R. P. Co.—Richard Pope Cowl.** Former Professor of English at Bristol University, England Author of *Poetic Theory in England, Text of Henry the Fourth, Pts I and II* in Arderne Shakespeare

**R. Pe.—Robert Peele.** Former Professor of Mining Engineering, School of Mines, Columbia University, Author of *Mining Engineers' Handbook; Compressed Air Plant,* 5th edition

**R. P. F.—Roland Post Falkner.** Statistician, Research Staff, National Industrial Conference Board, 1926–40 Assistant Director of the Census, 1911–12.

**R. P. G.—Robert P. Geyer.** Assistant Professor of Nutrition, Harvard School of Public Health, Boston, Mass

**R. P. H.—Raymond Prunty Holland.** President, American Game Protective Association. Editor of *Field and Stream,* 1924–41 Writer of shooting stories under the name of "Bob White."

**R. Pl.—Raymond Pearl.** Professor of Biology, 1923–40, and Director, Institute of Biological Research, 1925–30, The Johns Hopkins University, Baltimore, Md

**R. P. McC.—Richard P. McCormick.** Associate Professor of History, Rutgers University, New Brunswick, N.J. Author of *Experiment in Independence: New Jersey in the Critical Period, 1781–1789.*

**R. Pn.—Ralph Pearson.** Etcher and designer Author of *Prints of the Year;* etc

**R. Pr.—Robert Priebsch.** Professor of German Language and Literature in the University of London, 1902–31 Author of *Deutsche Handschriften in England;* etc.

**R. P. S.—Ralph Pray Seward.** Associate Professor of Chemistry, The Pennsylvania State College, State College, Pa

**R. P. Sp.—Robert Phillip Sharp.** Professor of Geology, California Institute of Technology, Pasadena, Calif.

**R. R.—Sir Richard Augustine Studdert Redmayne.** Member, Past President of Institute of Mining and Metallurgy; Honorary Member, Surveyors' Institute, H M Chief Inspector of Mines, 1908–20. Author of *The British Coal Industry During the War;* etc.

**Rr. C. An.—Roger Charles Anderson.** Author of *The Rigging of Ships, 1600–1720; The Sailing Ship.*

**R. Rd.—Robert Redfield.** Professor of Anthropology and Dean, Division of the Social Sciences, The University of Chicago. Author of *Tepoztlan, a Mexican Village; Chan Kom, a Maya Village; The Folk Culture of Yucatan.*

**R. Re.—Raymond Régamey.** Artist and designer. Author of *Gericault.*

**R. R. E.—Richard R. Ely.** Chief, Division of Philippine Affairs, U S. Department of State, Washington, D.C

**R. Ret.—Robert Retzer.** Director, Life Insurance Training Course, School of Commerce, Accounts and Finance, New York University, New York, N.Y., 1928–29.

**R. R. G.—Roy R. Grinker, M.D.** Chairman, Department of Neuropsychiatry, Michael Reese Hospital, Chicago, Ill. Author of *Neurology; Men Under Stress.*

**R. R. L.—Robert R. Linton, M.D.** Assistant Clinical Professor of Surgery, Harvard Medical School, Cambridge, Mass.

**R. R. M.—Robert Ranulph Marett.** Rector of Exeter College, Oxford, 1928–43. Former University Reader in Social Anthropology. Editor of *Anthropology and the Classics.* Author of *Anthropology; Psychology and Folklore;* etc.

**R. Rob.—Sir Robert Robinson.** Waynflete Professor of Chemistry, Oxford University, 1930– . Nobel Prize for Chemistry, 1947.

**R. R. P.—Raye R. Platt.** Head of Department of Hispanic American Research, American Geographical Society of New York.

**R. R. R.—Raymond Ronald Ridgway.** Former Associate Director of Research, Norton Company, Worcester, Mass., and Niagara Falls, Ont.

**R. Rs.—R. Ross.** Ministry of Agriculture and Fisheries, London.

**R. R. Sh.—Robert Ross Smith.** Historian, Pacific Section, Office of the Chief of Military History, U.S Department of the Army, Washington, D.C.

**R. Rt.—Reinhold Rost.** Editor of Wilson's *Essays on the Religions of the Hindus;* Hodgson's *Essays on Indian Subjects.*

**R. R. Th.—Reuben R. Thompson.** Editor, *Tobacco.*

**R. R. V.—Richard Rockhill Vogt.** Professor of Chemistry, University of Notre Dame, Notre Dame, Ind. Co-author of *The Chemistry of Acetylene.*

**R. R. W.—Russell Randolph Waesche.** Admiral, U S N. Former Commandant, United States Coast Guard

**R. Ry.—Robert Ridgway.** Former Chief Engineer, Board of Transportation, New York, N Y

**R. S.—Richard Seligman.** Sometime Chief Chemist to the British Aluminium Co., Ltd., London. Technical Managing Director of the Aluminium Plant and Vessel Company, Limited, London.

**R. S. Ba.—Ralph Samuel Bates.** Instructor in English and History, Massachusetts Institute of Technology, Cambridge, Mass. Author of *Scientific Societies in the United States.*

**R. S. C.—Rev. Richard Seymour Cripps.** Vicar of Horningsea, Cambs, Eng.

**R. Sch.—Robert Schmidt.** Former Director, Schlossmuseum, Berlin Author of *Brandenburgische Gläser; Das Glas; Mobel;* etc.

**R. S. Cl.—Reginald S. Clay.** President of the Royal Microscopical Society, 1937–38. Principal, Northern Polytechnic Holloway, London, 1902–31. Author of *Practical Exercises in Light;* etc.

**R. S. Cn.—Ronald Stephenson Cogdon.** Engineer, River Wear Commissioners, Sunderland, Eng.

**R. S. Co.—Robert Seymour Conway.** Former Professor of Latin and Indo-European Philology in the University of Manchester, England

**R. S. Cy.—Robert S. Casey.** Chief Chemist, W. A. Sheaffer Pen Company, Fort Madison, Ia.

**R. Sh.—Ralph Spaeth, M.D.** Assistant Professor of Pediatrics University of Illinois College of Medicine, Chicago, Ill.

**R. S. H.—Robert Selph Henry.** Vice-President, Association of American Railroads. Author of *This Fascinating Railroad Business; Portraits of the Iron Horse.*

**R. S. L.—Robert Strong Lewis.** Professor of Mining, University of Utah, Salt Lake City, Utah Author of section on Boring, *Peele's Mining Engineers' Handbook; Elements of Mining.*

**R. Sm.—Reed Smoot.** Former Senator from Utah and member of the World War I Foreign Debt Commission.

**R. S. M.—R. S. Morrell.** Research Chemist, Mander Bros., Ltd, Wolverhampton, England.

**R. S. Me.—Richard Stetson Morse.** President and Director of Research, National Research Corporation, Boston, Mass

**R. S. Mn.—Robert Swain Morison, M.D.** Assistant Director for the Medical Sciences, the Rockefeller Foundation, New York, N.Y. Former Assistant Professor of Anatomy, Harvard Medical School.

**R. S. P.—Reginald Stuart Poole.** Former Keeper of the Department of Coins and Medals, British Museum, London.

**R. S. Pa.—Richard S. Patterson.** Assistant to the Editor of the Treaties, Department of State, Washington, D.C.

**R. S. Pn.—Sir Ralph Sneyd Pearson.** Director, Forest Product Research Laboratories, Department of Scientific and Industrial Research, Princes Risborough, Bucks., England, 1925–33.

**R. S. R.—Sir Robert Sangster Rait.** Principal and Vice-Chancellor of the University of Glasgow, Scotland, 1929–36

**R. S. S.—Robert Sidney Smith.** Associate Professor of Economics, Duke University, Durham, N.C. Author of *The Spanish Guild Merchant;* etc.

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**R. S. Sr.—Russell Scott Stauffer.** Assistant Professor of Soil Physics, University of Illinois, Urbana, Ill.

**R. S. T.—Robert S. Thomas.** Military Historian, Historical Section, Army War College, Washington, D.C.

**R. Su.—Ronald Sutcliffe.** Principal Officer, British Government Chemist's Department, London.

**R. T.—Royall Tyler.** Author of *Byzantine Art;* etc.

**R. Ta.—R. Taylor.** Assistant, Chemical Research Laboratory, Teddington, Middlesex, England.

**R. Tay.—Richard Taylor.** U.S. cartoonist. Contributor to *The New Yorker* magazine, 1935–

**R. T. B. F.—Roger Thomas Baldwin Fulford.** Co-editor of *The Greville Memoirs;* author of *The Prince Consort; Queen Victoria; Royal Dukes*

**R. T. D.—Reginald Trevor Davies.** University Lecturer in Spanish History, Oxford University Tutor of St. Catherine's Society, Oxford Author of *Four Centuries of Witch-belief; The Golden Century of Spain.*

**R. T. F.—Russell Todd Fisher.** Former President, National Association of Cotton Manufacturers, Boston, Mass.

**R. T. G.—Robert Theodore Gunther.** Former Tutor in Natural Science and Librarian of Magdalen College, Oxford, Curator of the Lewis Evans Collection of Scientific Instruments, Oxford, 1924. Author of *Early Science in Oxford;* etc.

**R. T. Gl.—Sir Richard Tetley Glazebrook.** Former Fellow of Trinity College, Cambridge, and Chairman Aeronautical Research Committee. Director of the National Physical Laboratory, 1899–1919 Zaharoff Professor of Aviation and Director of the Department of Aeronautics, Imperial College of Science and Technology, University of London, 1920–23. Editor of *Dictionary of Applied Physics.*

**R. T. Go.—Rupert Thomas Gould.** Lieutenant Commander, R N. Former member of the British Horological Institute Author of *The Marine Chronometer: its History and Development;* etc

**R. T. J.—Robert Thomas Jenkins.** Emeritus Professor of Welsh History, University College of North Wales, Bangor, Wales. Author of *The Moravian Brethren in North Wales.* Editor of the Cymmrodorion *Dictionary of Welsh Biography.*

**R. T. McK.—Robert Tait McKenzie, M.D.** Former Research Professor of Physical Education, University of Pennsylvania, Philadelphia, Pa Author of *Exercise in Education and Medicine;* etc.

**Rt. P.—Robert Price.** Professor of Language and Literature, Otterbein College, Westerville, O. Co-author of *Johnny Appleseed: A Voice in the Wilderness.*

**R. T. P.—Roger Tory Peterson.** Author of *Field Guide to the Birds; Junior Book of Birds;* etc. Co-author of *The Audubon Guide to Attracting Birds.*

**R. Tu.—Ray Tucker.** Washington Columnist, "The National Whirligig," McClure Newspaper Syndicate, New York, N Y. Author of *Mirrors of 1932; Sons of the Wild Jackass.*

**R. T. W.—Robert T. Williams.** Specialist in Printing and Lithography, Carrier Engineering Corporation, Newark, N J. Author of *Manufactured Weather in the Printing and Lithographic Industries.*

**R. T. Wa.—Ralph Thomas Walker.** Architect Voorhees, Walker, Foley and Smith, New York, N Y.

**R. Uf.—Ruth Updegraff.** Professor of Preschool Education, Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Ia Author of *Practice in Preschool Education; Studies in Preschool Education.*

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**W. B. Fg.—William Buller Fagg.** Assistant Keeper, Department of Ethnography, British Museum, London. Hon. Secretary, Royal Anthropological Institute Author of *The Webster Plass Collection of African Art.*

**W. B. Fr.—William Bayne Fisher.** Senior Lecturer in Geography, University of Aberdeen, Aberdeen, Scot Author of *The Middle East: A Physical, Social and Regional Geography.*

**W. B. G.—William Benjamin Gregory.** Former Professor of Experimental Engineering and Hydraulics, Tulane University, New Orleans, La.

**W. B. H.—Walter Burton Harris.** Former Correspondent of the *Times* (London) in Morocco Author of *Morocco That Was.*

**W. B. He.—William B. Hesseltine.** Professor of History, University of Wisconsin, Madison, Wis. Author of *The South in American History;* etc

**W. B. Ho.—William Bowyer Honey.** Keeper, Department of Ceramics, Victoria and Albert Museum, London. Author of *Old English Porcelain;* etc.

**W. B. Ht.—W. Ben Hunt.** Author of *Indian and Camp Handicraft; Indiancraft.*

**W. Bi.—Walter Binni.** Professor of Italian Literature, University of Genoa, Genoa, It Author of *La poetica del decadentismo italiano;* etc.

**W. Bl.—Walter Blair.** Professor of English Literature, The University of Chicago.

**W. Bm.—William Bloom.** Professor of Anatomy, The University of Chicago.

**W. Bn.—Walter J. Brown.** Manager, Publicity Department, San Francisco Chamber of Commerce, San Francisco, Calif.

**W. B. P.—William Belmont Parker.** Former Editor of *South Americans of Today.* Author of *Chileans of Today; Paraguayans of Today;* etc.

**W. B. Pn.—Wheeler B. Preston.** Former author and publicist.

**W. B. Py.—Walter Bowers Pillsbury.** Emeritus Professor of Psychology, University of Michigan, Ann Arbor, Mich. Author of *History of Psychology; Fundamentals of Psychology.*

**W. Br.—William Brown, M.D.** Wilde Reader in Mental Philosophy and Director of the Institute of Experimental Psychology, Oxford University, 1936–45. Director of the Psychological Laboratory at King's College, University of London, 1908–21. Author of *Mind and Personality.*

**W. B. R.—Wilbur B. Rayton.** Former Director, Scientific Bureau, Bausch & Lomb Optical Company, Rochester, N.Y.

**W. B. R. K.—William Bernard Robinson King.** Professor of Geology, Cambridge University, 1943–

**W. Bro.—William Brown.** Professor of Plant Pathology of the University of London and Head of the Botanical Department at the Imperial College of Science and Technology, University of London.

**W. Bu.—William Charles Burges.** Town Clerk, City of Newcastle, Austr

**W. B. S.—William Barclay Squire.** Former Assistant in charge of Printed Music, British Museum, London, and Honorary Secretary of the Purcell Society.

**W. B. Sh.—Wilfred Byron Shaw.** Director, Bureau of Alumni Relations, University of Michigan, Ann Arbor, Mich Editor of *Michigan Alumnus: Quarterly Review.* Author of *The University of Michigan;* etc.

**W. B. Sm.—William Benjamin Smith.** Former Professor, Tulane University, New Orleans, La.

**W. Bu.—William Burrows.** Associate Professor of Bacteriology, The University of Chicago Author of *Textbook of Bacteriology.*

**W. B. W.—William Basil Worsfold.** Editor of the *Johannesburg Star,* 1904–05. Author of *A History of South Africa;* etc.

**W. B. Wo.—W. Birkbeck Wood.** Sometime Classical Scholar of Worcester College, Oxford Author of *A History of the Civil War in the United States.*

**W. By.—Hon. Wilfrid Bovey.** Member, Legislative Council Quebec, Canada. Author of *The French Canadian Today;* etc

**W. C. A.—W. C. Allee.** Head Professor of Biology, University of Florida, Gainesville, Fla Author of *Animal Aggregations; Social Life of Animals.*

**W. C. An.—William Christopher Atkinson.** Stevenson Professor of Spanish, University of Glasgow, Glasgow, Scot. Author of *Spain: A Brief History.*

**W. C. Re.—William Cabell Bruce.** Member of the United States Senate, 1923–29. Author of *John Randolph of Roanoke;* etc.

**W. C. Ben.—Wendell Clark Bennett.** Professor of Anthropology, Yale University, 1945–53. Associate Professor of Anthropology, University of Wisconsin, Madison, Wis, 1938–40.

**W. C. B. T.—William Cuthbert Brian Tunstall.** Lecturer in International Relations, London School of Economics. Lecturer in History and English, Royal Naval College, Greenwich, 1925–37 Member of B B.C Research Unit (Overseas), 1941. Naval Correspondent, B.B.C European Services, 1942–45. Author of *The Realities of Naval History;* etc.

**W. C. Dr.—Sir William Cecil Dampier.** Fellow of Trinity College, Cambridge, 1891. Sometime Chairman of the Home Office Committee on the Lighting of Factories and of the Machinery Committees of the Ministry of Agriculture Author of *The Theory of Experimental Electricity;* etc.

**W. C. G.—Wayne C. Grover.** Archivist of the United States. General Services Administration, Washington, D.C.

**W. C. Ha.—Sir William Clarke Hall.** Former Metropolitan Magistrate and Chairman of the Shoreditch Juvenile Court, England. Author of *The Law Relating to Children;* etc.

**W. C. J.—Warren C. Johnson.** Chairman, Department of Chemistry, and Associate Dean, Division of the Physical Sciences, The University of Chicago Author of *Ionic Equilibrium as Applied to Qualitative Analysis; Qualitative Analysis and Chemical Equilibrium.*

**W. Ck.—Walter Clark.** Technical Assistant to Vice-President in Charge of Research and Development, Eastman Kodak Company, Rochester, N Y Author of *Photography by Infrared: Its Principles and Practice.*

**W. C. K.—William Calvert Kneale.** Fellow of Exeter College, Oxford. Lecturer in Philosophy, Oxford University. Author of *Probability and Induction.*

**W. C. M.—Walter Conrad Muenscher.** Professor of Botany, Cornell University, Ithaca, N.Y. Author of *Weeds* (of the United States); *Poisonous Plants of the United States,* etc.

**W. C. N.—Winthrop C. Neilson.** President, Republic Mining and Manufacturing Company, Pittsburgh, Pa.

**W. C. Ny.—Wayne C. Neely.** Professor of Sociology, Hood College, Frederick, Md. Author of *The Agricultural Fair.*

**W. C. P.—W. Conway Pierce.** Chairman, Department of Chemistry, Pomona College, Claremont, Calif. Author of *Quantitative Analysis.*

**W. Cr.—Walter Crane.** Art Director of Reading College, England, 1896. Principal of the Royal College of Arts, 1898.

**W. C. R.—William C. Reavis.** Emeritus Professor of Education, The University of Chicago. Author of *Administering the Elementary School; Duties of School Principals.*

**W. Cro.—William Crocker.** Former Managing Director of the Boyce Thompson Institute for Plant Research, Inc, Yonkers, N Y.

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**W. Da.—W. Dalton.** Author of *Bridge Abridged, or Practical Bridge.*

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**W. D. C.—William D. Clark.** Former Assistant Director, British Information Services, Chicago, Ill.

**W. de B. H.—William de Bracy Herbert.** Former Recorder of Newcastle under Lyme, England.

**W. D. F.—Walter Deane Fuller.** President, Curtis Publishing Company, Philadelphia, Pa.

**W. D. G.—William D. Grampp.** Vice-Consul in the American Foreign Service Auxiliary, the Department of State. Former Professor of Economics, Elmhurst College, Elmhurst, Ill.

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**W. Dk.—William Dameshek, M.D.** Professor of Clinical Medicine, Tufts College Medical School, Medford, Mass. Senior Physician and Haematologist, New England Center Hospital, Boston, Mass.

**W. D. Kr.—Walter David Keller.** Professor of Geology, University of Missouri, Columbia, Mo Author of *Common Rocks and Minerals of Missouri.*

**W. D. L.—William Draper Lewis.** Director, American Law Institute, Philadelphia, Pa, 1923–47. Professor of Law, University of Pennsylvania, Philadelphia, 1896–1924, Dean of Law Department, 1896–1914. Editor of *Great American Lawyers;* etc.

**W. D. La.—Walter Davis Lambert.** Principal Mathematician and Chief of the Section of Gravity and Astronomy, U S. Coast and Geodetic Survey. Author of *The Effect of the Change of Spheroid on the Mapping of a Region;* etc.

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**W. D. Oy.—William D. Owsley.** Vice-President for Engineering Advice to Management, Halliburton Oil Well Cementing Company, Duncan, Okla. Author of *Drilling Practices.*

**W. Ds.—William Davis.** Professor of Textile Industries, University College, Nottingham, England.

**W. Du.—William James Durant.** Author of *The Story of Philosophy;* etc.

**W. Dy.—Walter Duranty.** Correspondent of North American Newspaper Alliance in Europe, U.S.S.R., Japan, 1939–41 Correspondent in Moscow for *The New York Times,* 1921–34. Author of *The Kremlin and the People;* etc.

**W. E.—William Henry Eccles.** President of the Institute of Electrical Engineers, 1926–27. Former Professor of Applied Physics and Electrical Engineering City and Guilds of London Technical College, Finsbury.

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**W. E. A. A.—William Edmund Armytage Axon.** Sometime Deputy Chief Librarian of the Manchester Free Libraries, Manchester, England.

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**W. E. B.—William Edgar Borah.** United States Senator from Idaho, 1907–43.

**W. E. Ba.—William Emery Barnes, D.D.** Former Fellow of Peterhouse, Professor of Divinity and Dean, Christ's College, University. Hulsean Professor of Divinity, Cambridge, 1901–34.

**W. E. Bn.—Walton E. Bean.** Instructor in History, University of California, Berkeley, Calif.

**W. E. Bt.—William E. Brandt.** Author and radio commentator.

**W. E. By.—Wilfred E. Binkley.** Professor of Political Science, Ohio Northern University, Ada, O. Author of *American Political Parties: Their Natural History; President and Congress.*

**W. E. C.—Walter E. Collinge.** Keeper of the Yorkshire Museum, York, England, 1933–47 Former Editor of *The Journal of Zoological Research,* and Lecturer on Economic Zoology, University of Birmingham.

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**W. E. Co.—Rt. Rev. William Edward Collins, D.D.** Former Bishop of Gibraltar. Former Professor of Ecclesiastical History, King's College, University of London, and Lecturer, St. John's and Selwyn Colleges, Cambridge Author of *The Beginnings of English Christianity*

**W. E. Cu.—William Edward Curtis.** Professor of Physics, King's College, Newcastle-on-Tyne, University of Durham, England Scientific Adviser, Research and Experiments Department, Ministry of Home Security, 1940–43

**W. E. Cx.—Warren Earle Cox.** Lecturer on decoration and craftsmanship

**W. E. D.—W. Ernest Dalby.** Former Dean and Professor of Engineering at the City and Guild's Engineering College of the Imperial College of Science and Technology, University of London.

**W. E. Dn.—Walter Edmund Doran.** Chief Engineer, Great Ouse River Board, Cambridge, Eng.

**W. E. E.—Walter Elmer Ekblaw.** Professor of Geography, Clark University, Worcester, Mass., 1926–49. Assistant Editor, *Economic Geography,* 1924–49.

**W. E. F.—W. E. Forsythe.** Physicist, General Electric Company, Cleveland, O, 1913–46 Co-author of *Fluorescent Lamps.*

**We. G.—Werner Goldschmidt.** Profesor contratado de dedicacion exclusiva de Derecho Internacional Privado Director of the corresponding section at the National University of Tucumán, Tucumán, Arg. Author of *Sistema y filosofía del Derecho Internacional Privado, con especial consideracion del Derecho Internacional Privado Español.*

**W. E. Gr.—Walter Ervin Gloor.** Plastics Supervisor, Hercules Powder Company, Parlin, N J

**W. E. Gs.—Willard E. Givens.** Executive Secretary of the National Education Association, 1935–

**W. E. H.—William Ernst Hocking, D.D.** Chairman of Department of Philosophy, Harvard University, 1937–43. Author of *The Meaning of God in Human Experience; Science and the Idea of God;* etc.

**W. E. Hd.—W. E. Howland.** Professor of Sanitary Engineering and Educational Consultant to the Dean of Engineering, Purdue University, Lafayette, Ind.

**W. E. I.—William Edmund Ironside, 1st Baron Ironside of Archangel and of Ironside.** Field Marshal. Commander in Chief, Home Forces, 1940 Commander in Chief, Allied Troops in Russia, 1918–19. Commandant, Staff College, Camberley, 1922–26. Chief of the Imperial General Staff, 1939–40. Author of *Tannenberg: The First Thirty Days in East Prussia.*

**W. E. K. M.—William E. Knowles Middleton.** Meteorologist, Meteorological Service, Toronto, Ont., Can. Author of *Visibility in Meteorology;* etc.

**W. E. L.—William Egbert Leveson.** Assistant Secretary, 1896–1906, and Secretary, 1906-18, to the Council for the Foreign Community of Shanghai north of the Yang King Pang.

**W. E. M.—W. E. Morton.** Professor of Textile Technology in the University of Manchester, England Author of *An Introduction to the Study of Spinning;* etc.

**W. E. Ma.—Wilbur E. Mallalieu.** General Manager, National Board of Fire Underwriters, New York, N Y.

**W. E. My.—William Edward May.** Commander, Royal Navy Naval Assistant to Director, Compass Department, Admiralty.

**W. En.—William Ebenstein.** Associate Professor of Political Science, University of Wisconsin, Madison, Wis. Author of *The Nazi State;* etc.

**W. E. P.—William E. Powers.** Professor of Geography, Northwestern University, Evanston, Ill. Co-author of *Introduction to Weather and Climate.*

**W. E. S.—Walter Earl Spahr.** Professor of Economics, School of Commerce, Accounts and Finance, and Chairman of the Department of Economics, New York University

**W. E. Ss.—Wayne Edson Stevens.** Professor of History, Dartmouth College, Hanover, N H.

**W. E. T.—William Edward Tate.** Lecturer, University of Leeds, Leeds, Eng. Author of *His Worship the Mayor; The Parish Chest* Editor of *English Inn Signs*

**W. E. Th.—Wendell E. Thorne.** International Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System.

**W. E. W.—W. E. Wornum.** Technical and Research Chemist, Mander Brothers, Ltd, Wolverhampton, England.

**W. E. Wa.—William E. Warne.** Assistant Secretary, Department of the Interior, Washington, D C Assistant Commissioner, Bureau of Reclamation, Department of the Interior, 1943–47.

**W. E. Wh.—Wallace Edward Whitehouse.** Acting Head of Department of Geography, University College of Wales, Aberystwyth, 1941–46.

**W. F.—William Fairweather, D.D.** Minister of Dunniker, United Free Church, Kirkcaldy, N.B. Author of *The Background of the Gospels;* etc.

**W. F. A.—William F. Albright** Chairman, Oriental Seminary, Th[illegible] University, Baltimore, Md Author of *The Excavation of Tell Beit Mirsim; From the Stone Age to Christianity.*

**W. F. B.—Walter Francis Bogner.** Architect. Associate Professor of Architecture, School of Design, Harvard University.

**W. F. C.—William Feilden Craies.** Former Lecturer on Criminal Law, King's College, University of London. Editor of Archbold's *Criminal Pleading* (23rd edition).

**W. F. Cs.—William F. Christians.** Associate Professor of Geography, Wharton School, University of Pennsylvania, Philadelphia, Pa. Co-author of *Economic Geography of South America.*

**W. Fd.—Walter Armitage Justice Ford.** Former Professor of Singing at the Royal College of Music and University of Reading, England.

**W. F. D.—Walter Fairleigh Dodd.** Professor of Law, 1927–30, and Research Associate Professor, 1930–33, Yale University. Author of *Modern Constitutions;* etc.

**W. F. F.—William Frederick Friedman.** Principal Cryptanalyst, U.S. War Department, Washington, D.C. Director of Signal Intelligence School, War Department. Chief of Signal Intelligence Service, 1930–40. Author of *Elements of Cryptanalysis;* etc.

**W. F. Fr.—Walter Francis Frear.** Chief Justice, 1900–07, and Governor, 1907–13, of Hawaii Former Vice-President, Bishop Trust Company, Honolulu, Hawaii Author of *Evolution of the Hawaiian Judiciary;* etc.

**W. F. I.—William Fergusson Irvine.** Local secretary for Cheshire for the Society of Antiquaries, 1909– Hon. Secretary and Genera. Editor of Record Society of Lancashire and Cheshire, 1895–1909 Author of *Liverpool in the Reign of Charles II;* etc.

**W. F. K.—Winifred F. Knox.** Author of *The Court of a Saint.*

**W. F. L.—Walter Firth Lanterman.** Engineer, National Broadcasting Company, Chicago, Ill.

**W. F. M.—William Frederick Meggers.** Chief Spectroscopy Section, National Bureau of [illegible] D C.

**W. Fo.—Wolfgang Foerster.** Lieutenant Colonel, formerly of the General Staff, German Army Former Member of the Historical section of the General Staff Chief of the General Staff of the XI Corps, 1917 Author of *Prinz Friedrich Karl von Preussen; Graf Schlieffen und der Weltkrieg*

**W. F. P.—William F. Parish.** Consulting and lubricating engineer, New York Member, American Society of Mechanical Engineers, etc.

**W. F. R.—William Frank Rasche.** Director and Principal, Milwaukee Vocational School, Milwaukee, Wis.

**W. F. Re.—William Fiddian Reddaway.** Former Fellow of King's College, Cambridge, and University Lecturer. Censor of Fitzwilliam House, Cambridge Eng., 1907–24. Author of "[illegible] in the *Cambridge Modern History.*

**W. F. S.—William Fleetwood Sheppard.** Former Fellow of Trinity College, Cambridge Senior Examiner to the Board of Education.

**W. F. Sw.—W. F. Swann.** Technical Correspondent, Sales Service Division, Eastman Kodak Company, Rochester, N.Y.

**W. Ft.—Wesley Frost.** Former U.S Ambassador to Paraguay. Author of *German Submarine Warfare*

**W. F. W.—Walter Francis Willcox.** Emeritus Professor of Economics and Statistics, Cornell University, Ithaca, N.Y Special Agent of the U S Census Bureau, 1902–31. Author of *The Divorce Problem—a Study in Statistics;* etc.

**W. G.—William Green.** President of the American Federation of Labor, Washington, D.C.

**W. Ga.—Walter Garstang.** Former Professor of Zoology in the University of Leeds, England. Vice-President, Marine Biological Association, 1940.

**W. G. A.—Walter Gordon Armstrong.** Assistant to the President, Youngstown Pressed Steel Company, Warren, O.

**W. Gam.—W. Gamble.** Editor, *Penrose's Annual.*

**W. Gar.—W. Garnett.** Educational Advisor to the London County Council, 1904–15.

**W. G. B.—Walter George Bell.** Author of *The Great Fire of London in 1666; The Great Plague in London in 1665; Unknown London;* etc.

**W. G. C.—Walter Goodman Cowles.** Former Vice-President, Travelers Insurance Company, Hartford, Conn.

**W. G. D.—William G. Downey, Jr.** Major, U S Army Chief, International Law Branch, Office of the Judge Advocate General. Author of *American Maritime Neutrality Policy; Revision of the Rules of Warfare.*

**W. Gr.—Sir Wilfred T. Grenfell, M.D.** Author of *An Autobiography of a Labrador Doctor;* etc.

**W. G. M.—Walter George McMillan.** Former Secretary of the Institute of Electrical Engineers and Lecturer on Metallurgy, Mason College, Birmingham. Author of *A Treatise on Electro-Metallurgy.*

**W. G. P.—Wibo G. Peekema.** Legal Adviser, Standard-Vacuum Petroleum Co.

**W. Gr.—William Graham.** Former M P. for the Central Division of Edinburgh. Financial Secretary to the Treasury, 1924.

**W. G. R.—Will G. Robinson.** Secretary, South Dakota State Historical Society. Author of *South Dakota in World War II.*

**W. Gs.—Walter Adolph Gropius.** Senior Professor of Architecture and Chairman of School of Architecture, Harvard University.

**W. G. W.—William Gillies Whittaker.** Gardiner Professor of Music, Glasgow University, and Principal, Scottish National Academy of Music, 1930–41

**W. G. Wt.—William G. Watt.** Director, Division of Maritime Security, U S. Navy Hydrographic Office, Washington, D.C.

**W. H.—Sir (Thomas) Wolseley Haig.** Lieutenant Colonel Former Lecturer in Persian, School of Oriental Studies, University of London. H B M.'s Consul-General and Agent to the Government of India, Khurasan, Persia, 1914–16; Isfahan, 1916, Tehran, 1919. Co-editor of the *Cambridge History of India.*

**W. Ham.—Walter Hampden.** Actor manager.

**W. H. B.—William H. Burnham.** Former Professor of Education and School Hygiene, Clark University, Worcester, Mass. Author of *The Normal Mind; Great Teachers and Mental Health.*

**W. H. Ba.—W. H. Balzer.** Research Engineer, Staff of Ansonia Clock Company, Brooklyn, N.Y.

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**W. H. Be.—William Henry Bennett, D.D.** Former Professor of Old Testament Exegesis in New and Hackney Colleges, London. Author of *Religion of the Post Exilic Prophets;* etc.

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**W. H. Ca.—Willis Haviland Carrier.** Former President, American Society of Heating and Ventilating Engineers. Co-author and editor, *Fan Engineering.*

**W. H. Ch.—William Henry Chamberlin.** American correspondent for the *Christian Science Monitor* in France, 1939– , in the Soviet Union, 1922–34, the Far East, 1935–38 Author of *Soviet Russia; Russia's Iron Age; Japan Over Asia;* etc.

**W. H. Cl.—Sir William Henry Clark.** Former Director of Barclay's Bank, etc. Comptroller-General of Department of Overseas Trade, 1918–28. High Commissioner in Union of South Africa for H.M. Government in United Kingdom, 1934–39.

**W. H. Cr.—Walter Hill Crockett.** Former Editor of Publications, University of Vermont, Burlington, Vt.

**W. H. Dr.—William Hamilton Drummond, D.D.** Honorary President Manchester College, Oxford, 1938–42 Secretary of the International Congress of Free Christians and other Religious Liberals, 1920–29.

**W. H. D. R.—William Henry Denham Rouse.** University Teacher of Sanskrit, Cambridge University, 1903–39; Head Master Perse Grammar School, Cambridge 1902–28. Author of *Latin on the Direct Method.*

**W. H. F.—Rt. Rev. Walter Howard Frere, D.D.** Bishop of Truro, 1923–35. Examining Chaplain to the Bishop of Southwark, 1895–1909. Author of *The Marian Reaction; Sursum Corda;* etc.

**W. H. H.—Sir William Henry Hadow.** Vice-Chancellor, University of Sheffield, England, 1919–30. Former Member of Council, Royal College of Music Editor, *Oxford History of Music.* Author of *Studies in Modern Music; Sonata Form;* etc.

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**W. H. M.—William Henry Maxwell.** Borough and Waterworks Engineer, Tunbridge Wells, England. Former President Institute of Sanitary Engineers, London. Author of *Removal and Disposal of Refuse.*

**W. H. Ma.—William Herrick Macaulay.** Former Fellow and Tutor of King's College, Cambridge Author of *The Law of Thermodynamics;* etc.

**W. H. Mi.—William Hobson Mills.** Emeritus Reader in Stereochemistry and Fellow and President [illegible] lege, Cambridge. President Chemical Society, 1941–43.

**W. H. Mk.—Walter Heinrich Munk.** Associate in Oceanography, Scripps Institution of Oceanography, University of California, La Jolla, Calif.

**W. Hn.—Wilder Hobson.** Author of *American Jazz Music.*

**W. H. N.—W. H. Nalder.** Chief Designing Engineer, U.S. Bureau of Reclamation, Denver, Colo.

**W. Ho.—William Hodson.** Commissioner of Public Welfare, New York City, 1934–43.

**W. H. O.—Wilfred H. Osgood.** Former Curator of Zoology, Chicago Natural History Museum, Chicago, Ill.

**W. H. P.—Wallace H. Paull.** Technical Director of the Dunlop Rubber Co, Ltd., Birmingham, England.

**W. H. P. F.—William H. P. Faunce, D.D.** Former President of Brown University, Providence, R I Former President, World Peace Foundation Author of *The Educational Ideal in the Ministry;* etc

**W. H. Po.—Walter Herries Pollock.** Editor of *Saturday Review,* 1883–94 Author of *Lectures on French Poets;* etc.

**W. Hr.—William Holtzheuer.** Of the Continental Caoutchouc and Gutta Percha Company, Hanover, Germany.

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**W. H. U.—William H. Ukers.** Former Editor, *The Tea and Coffee Trade Journal.* Author of *All About Coffee; All About Tea;* etc.

**W. H. Wh.—William Henry Wheeler.** Director, Projectile Development, Ministry of Supply, Eng.

**W. H. Wi.—Sir William Henry Willcox, M.D.** Colonel. Medical Adviser to Home Office, 1919–41. Physician, Lecturer on Chemical Pathology and on Forensic Medicine, St. Mary's Hospital, London, 1900–35.

**W. H. Wo.**—**William H. Woodcock.** Member of the Society of Public Analysts

**W. H. Wr.**—**William Hammond Wright.** Director (1935–42) and Emeritus Astronomer, Lick Observatory University of California. In charge of the Lick Observatory's Expedition to the Southern Hemisphere, 1903–06

**W. H. Wt.**—**Willard Hull Wright.** Scientist Director (Colonel), U S Public Health Service. Chief, Division of Tropical Diseases, National Institutes of Health, Bethesda, Md.

**W. I.**—**Will Irwin.** Author of *Youth Rides West; Propaganda and the News;* etc

**Wi. H.**—**Wilfried Heller.** Research Associate and Lecturer in Colloid Chemistry, The University of Chicago Author of *Nouvelles Recherches sur Les Propriétés Magneto-Optiques des Solutions Colloidales*, etc

**W. I. J.**—**William Ivor Jennings.** Vice-Chancellor, University of Ceylon. Author of *Cabinet Government; Parliament*

**W. I. K.**—**Willford Isbell King.** Professor of Economics, New York University School of Commerce Author of *The Wealth and Income of the People of the United States;* etc.

**Wi. Mr.**—**William Miller.** Editor, Alfred A Knopf, Inc, New York, N Y Author of *The Age of Enterprise: a Social History of Industrial America.*

**W. J.**—**W. Jutzi.** Dyeworks and Chemical Industries Amalgamation, Ludwigshafen, Germany.

**W. J. B.**—**Sir William John Berry.** Director of Naval Construction, Admiralty, 1924–30. Director of Warship Production, 1917–23.

**W. J. Bg.**—**Wilfred Joseph Bigg.** Head of the Communications Department, Colonial Office, London.

**W. J. Bp.**—**William John Bishop.** Librarian, Wellcome Historical Medical Library, London. Co-author of *Notable Names in Medicine and Surgery.*

**W. J. Br.**—**Rev. William Jackson Brodribb.** Former Fellow of St. John's College, Cambridge.

**W. J. Ch.**—**William Joseph Chipman.** Former Football Editor, New York *Daily News,* New York, N Y.

**W. J. D.**—**William John Dakin.** Former Professor of Zoology, University of Sydney, Australia Former Professor of Biology in the University of Western Australia. Author of *Textbooks on Zoology;* etc.

**W. J. Do.**—**William John Donald.** Managing Director, National Electrical Manufacturers Association, New York, N.Y. Author of *Canadian Iron and Steel Industry; Trade Associations;* etc. Editor in Chief, *Handbook of Business Administration.*

**W. J. Don.**—**William Joseph Donovan.** Major General, U.S.A. Co-ordinator of Information and Director of Strategic Services, Washington, D.C U S. Commissioner and Chairman, Colorado River Commission.

**W. J. E.**—**W. J. Everard.** Director of F. T. Everard and Sons, Ltd.

**W. J. E. B.**—**William James Eames Binnie.** Consulting Engineer, Senior Partner of firm of Binnie, Deacon and Gourley, London. President of Institution of Civil Engineers, 1938–39.

**W. J. Et.**—**Wallace John Eckert.** Professor of Celestial Mechanics, Columbia University, New York, N Y Author of *Punched Card Methods in Scientific Computation.*

**W. J. F.**—**William J. Filbert.** Former Director and Chairman of Finance Committee. United States Steel Corporation, New York, N Y.

**W. J. Gru.**—**William John Gruffydd.** Emeritus Professor of Celtic, University College of South Wales and Monmouthshire, Cardiff, Wales Author of *History of Welsh Literature (1450–1600); History of Welsh Prose (1540–1660);* etc.

**W. J. H.**—**William James Hughan.** Past-Senior Grand Deacon of [illegible] of England, 1874 Honorary Senior Warden of Grand Lodges of Egypt, Quebec and Iona

**W. J. Hs.**—**William Jackson Humphreys.** Retired government scientist Author of *Physics of the Air; Ways of the Weather;* etc.

**W. J. J.**—**William Jackson Jenks.** Chairman of the Board, Norfolk & Western Railway Company

**W. J. L.**—**William John Loeffel.** Professor of Animal Husbandry and Chairman, Animal Husbandry Department, Univ. of Nebraska, Lincoln, Neb

**W. J. Lu.**—**Rev. William J. Lallou, S.T.D.** Associate Professor of Sacred Liturgy, Catholic University of America, Washington, D C

**W. J. M.**—**William John McCallien.** Professor of Geology, University College of the Gold Coast, Achimota, Gold Coast. Author of *Geology of the Glasgow District; Scottish Gemstones.*

**W. J. Ry.**—**W. J. Rooney.** Physicist, Carnegie Institution of Washington, Department of Terrestrial Magnetism

**W. J. T. H.**—**W. J. T. Halliwell.** Former Principal Pilotage Clerk, Trinity House, London.

**W. K.**—**Wolfgang Köhler.** Professor of Psychology, Swarthmore College, Swarthmore, Pa., 1935– . Author of *The Mentality of Apes; The Place of Value in a World of Facts;* etc.

**W. K. G.**—**William King Gregory.** Emeritus Curator of the Department of Comparative Anatomy and Department of Ichthyology, American Museum of Natural History, New York Emeritus Professor of Vertebrate Palaeontology, Columbia University. Author of *The Orders of Mammals;* etc.

**W. K. L. C.**—**William Kemp Lowther Clarke, D.D.** Canon Residentiary of Chichester Cathedral, 1945– . Editorial Secretary of Society for Promoting Christian Knowledge, 1915–44. Author of *St. Basil the Great;* etc.

**W. K. McC.**—**Sir William Kidston McClure.** Former Counsellor, British Embassy, Rome Former correspondent of *The Times* (London) in Rome War Correspondent of *The Times* on the Italian Front, 1915–17. Author of *Italy's Part in the War;* etc.

**W. Kt.**—**Waldemar Kaempffert.** Science Editor, the *New York Times.* Author of *Explorations in Science; History of Astronomy; Popular History of American Invention; Science Today and Tomorrow.*

**W. L.**—**Walter Landells.** London Stock Exchange.

**W. La.**—**William Latey.** Of the Middle Temple, and the Probate and Divorce Courts, Barrister-at-Law

**W. L.** [illegible] **Ayers.** Former Director [illegible], International Bank for Reconstruction and Development, Washington, D C

**W. L. B.**—**William Lewis Blennerhassett.** Former Acting British Vice-Consul at Kovno, Lithuania Member of the London Stock Exchange.

**W. L. Bd.**—**William Leslie Bradford, M.D.** Associate Professor of Pediatrics and Assistant Dean, University of Rochester School of Medicine and Dentistry, Rochester, N Y.

**W. L. Bn.**—**William Laurence Burn.** Professor of Modern History, King's College, University of Durham, Newcastle-upon-Tyne, Eng. Author of *The British West Indies; Emancipation and Apprenticeship in the British West Indies.*

**W. L. D.**—**Wilfred L. Denno.** Warden of Sing Sing Prison, Ossining, N Y.

**W. L. de B.**—**William Lane de Baufre.** Chairman, Department of Engineering Mechanics, University of Nebraska, Lincoln, Neb.

**W. L. F.**—**Walter Lynwood Fleming.** Former Dean, College of Arts and Sciences, Vanderbilt University, Nashville, Tenn Author of *Documentary History of Reconstruction.*

**W. L. Fk.**—**William L. Frederick.** Research Associate, Council of State Governments.

**W. L. G.**—**William Lawson Grant.** Former Principal of Upper Canada College, Toronto Beit Lecturer in Colonial History at Oxford University, 1906–10 Professor of Colonial History, Queen's University, Kingston, Canada, 1910–15 Editor of *Acts of the Privy Council, Canadian Constitutional Development* (in collaboration).

**W. L. Gn.**—**W. Lashford Griffin.** Director of Messrs William Griffin and Sons, Ltd., Chain Manufacturers, Cradley Heath, Staffs., England.

**W. L. H. D.**—**Wynfrid Laurence Henry Duckworth, M.D.** Master of Jesus College, Cambridge, 1940–45; Reader in Human Anatomy, 1920–40.

**W. Li.**—**Walter Lippmann.** Special Writer, *New York Herald Tribune.* Former Editor of *New York World.* Author of *Liberty and the News;* etc.

**W. L. J.**—**William L. Jellison.** Sanitarian, United States Public Health Service, Rocky Mountain Laboratory, Hamilton, Mont.

**W. L. P.**—**William Lyon Phelps, D.D.** Lampson Professor of English Literature, Yale University, 1901–33 Author of *Some Makers of American Literature;* etc.

**W. L. R.**—**William L. Rodgers.** Vice-Admiral, U S N. Commander in Chief of the United States Asiatic Fleet, 1918–19.

**W. L. St.**—**Waldo L. Schmitt.** Head Curator of Zoology, United States National Museum, Washington, D C. Author of *The Marine Decapod Crustacea of California;* etc.

**W. L.-W.**—**Sir William Lee-Warner.** Former Secretary in the Political and Secret Department of the India Office. Author of *Life of the Marquis of Dalhousie;* etc.

**W. L. W.**—William Lansdell Wardle, D.D. Former Reader in Biblical Criticism and Exegesis of the Old Testament, Manchester University, England Principal of Hartley Victoria College, Manchester, 1928–1943.

**W. L. Wh.**—Wilford Lenfestey White. Chief of Management Division, Office of Small Business, 1946–52 Chief of the Division of Marketing Research, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D C, 1934–39; Chief, Publication Service Division, 1939–41; Chief, Regional Research Unit, 1941–45.

**W. M.**—William Miller. Author of *The Latins in the Levant; The Ottoman Empire and Its Successors (1801–1936); Greece;* etc.

**W. Mar.**—Sir William Markby. Former Judge, High Court of Calcutta, Reader in Indian Law, Oxford University. Author, *Lectures on Indian Law;* etc.

**W. M. Ca.**—William M. Carpenter. Economist, Edison Electric Institute Author of *The Electric Light and Power Industry, Its Facts and Figures;* etc.

**W. McD.**—William McDougall. Former Professor of Psychology in Duke University, Durham, N C.; formerly of Harvard University and Reader in Mental Philosophy in Oxford University.

**W. M. Ck.**—W (illiam) Mansfield Clark. De Lamar Professor of Physiological Chemistry, The Johns Hopkins School of Medicine, Baltimore, Md Author of *The Determination of Hydrogen Ions.*

**W. M. D.**—William Morris Davis. Former Professor of Geology, Harvard University. Author of *Physical Geography.*

**W. Me.**—Wilfrid Meynell. Editor of the *Collected Works* of Francis Thompson and of Alice Meynell.

**W. M. F. P.**—Sir William M. Flinders Petrie. Emeritus Professor of Egyptology, University College, University of London, 1933–42. Excavator of Giza, etc.

**W. M. Gn.**—William M. Gibson. Professor of English, New York University, New York, N.Y. Co-author of *A Bibliography of William Dean Howells; Readings for Liberal Education.*

**W. M. H.**—William M. Hines, Jr. Writer. Associate Editor, *The Manassas Journal,* Manassas, Va.

**W. M. H. G.**—W. M. H. Greaves. Astronomer Royal for Scotland and Professor of Astronomy, Edinburgh University.

**W. M. Je.**—William Martin Jeffers. Former Vice-Chairman, Board of Directors, and former General Manager, Union Pacific Railroad, Omaha, Neb.

**W. M. L.**—William M. Leiserson. Industrial relations consultant and arbitrator. Author of *Adjusting Immigrant and Industry; Right and Wrong in Labor Relations.*

**W. M. La.**—Wendell Mitchell Latimer. Dean, College of Chemistry, University of California, Berkeley, Calif.

**W. M. M.**—William Moulton Marston. Consulting Psychologist, Tufts College, Medford, Mass., 1925–47. Author of *Emotions of Normal People; Psychology* (textbook).

**W. M. McG.**—William M. McGovern. Professor of Political Science, Northwestern University, Evanston, Ill. Lecturer, Naval War College. Author of *Early Empires of Central Asia; From Luther to Hitler; Modern Japan.*

**W. M. Mn.**—William M. Mann. Director, National Zoological Park, Washington, D.C.

**Wm. O.**—William Osmun. Associate Keeper, Department of Exhibitions, Cooper Union Museum for the Arts of Decoration, New York, N.Y.

**W. M. Pn.**—William M. Pinkerton. Director, News Office, Harvard University.

**W. M. R.**—William Michael Rossetti. One of the founders of the Pre-Raphaelite Brotherhood. Former Editor of *The Germ.* Author of *Lives of Famous Poets;* etc.

**W. M. Ra.**—Sir William Mitchell Ramsay, D.D. Professor of Humanity, Aberdeen University, Scotland, 1886–1911; of Classical Art, Oxford University, 1885

**W. M. S.**—William Marshall Smart. Regius Professor of Astronomy, University of Glasgow, Scotland, 1937– . John Couch Adams Astronomer and Lecturer in Mathematics, Cambridge University, 1919–37 Author of *The Sun, the Stars and the Universe;* etc.

**W. M. Sl.**—William Milligan Sloane. Former Professor of History, Columbia University. Secretary to George Bancroft while Ambassador in Berlin. Author of *Life of Napoleon Bonaparte.*

**Wm. Sp.**—William Sprargen. Director, Welding Research Council, Engineering Foundation. Editor, *Welding Journal.* Editor, *Welding Engineers Handbook.*

**W. M. U.**—Wilbur Marshall Urban. Emeritus Professor of Philosophy, and Chairman Department of Philosophy and Director of Graduate Studies, Yale University Author of *Valuation—Its Nature and Laws;* etc.

**W. M. W.**—Walter Muir Whitehill. Commander, U S.N.R. (inactive). Director and Librarian, Library of the Boston Athenaeum, Boston, Mass. Editor, *The American Neptune: A Quarterly Journal of Maritime History;* etc.

**W. M. We.**—Willard M. Wallace. Associate Professor of History, Wesleyan University, Middletown, Conn. Author of *Appeal to Arms: a Military History of the American Revolution;* etc.

**W. N. D.**—William Nelson Davey. Director, Johnson and Higgins, Average Adjusters and Insurance Brokers, New York, N.Y.

**W. N. H.**—(Walter) Norman Haworth. Former Professor of Chemistry and Director of Department of Chemistry in the University of Birmingham Vice-Principal, University of Birmingham, England, 1947–50 Nobel Prize for Chemistry, 1937.

**W. N. J.**—W. Neilson Jones. Hildred Carlile Professor of Botany, University of London. Author of *Plant Chimaeras and Graft Hybrids;* etc.

**W. N. K.**—William Norton Keeler. General Manager Sun-Maid Raisin Growers' Association, Fresno, Calif. Vice-President and Director of Dried Fruit Association of California.

**W. O. B.**—Rt. Rev. Winfrid Oldfield Burrows, D.D. Bishop of Chichester, England, 1919–29. Honorary Canon of Birmingham, 1906–12. Lecturer in Pastoral Theology, Cambridge University, 1910–11. Lord Bishop of Truro, 1912–1919. Author of *The Mystery of the Cross.*

**W. O. E. O.**—William O. E. Oesterley, D.D. Former Examining Chaplain to the Bishop of London. Former Professor, Hebrew and Old Testament Exegesis, King's College, London University. Author of *The Books of the Apocrypha: their Origin, Contents and Teaching;* etc.

**W. O.-J.**—W. Olfar-Jevsky. Graduated as architect from Moscow Academy of Fine Arts.

**W. O. L. S.**—William Owen Lester Smith. Professor of Education, London University Institute of Education. Author of *To Whom Do Schools Belong?,* etc.

**W. Or.**—Winfred Overholser, M.D. Superintendent of Saint Elizabeths Hospital, Washington, D.C Professor of Psychiatry, George Washington University School of Medicine, Washington, D.C.

**W. O. S.**—William Oscar Scroggs. Dean Graduate School, 1941–49, and Professor of Economics and Sociology, 1913–19, Louisiana State University, Baton Rouge, La. Editorial staff, *New York World,* 1925–31. Author of *Filibusters and Financiers;* etc

**W. P.**—Woodford Patterson. Former Secretary, Cornell University, Ithaca, N.Y.

**W. Pa.**—Rev. W. Paton. Editor of *The International Review of Missions,* 1927–1943.

**W. P. A.**—William Patrick Anderson. Colonel. Former Chief Engineer, Department of Marine and Fisheries of Canada, and Member of the Geographic Board of Canada.

**W. Pas.**—Rev. Wilfrid Parsons, S.J. Professor of Political Science, Catholic University, Washington, D.C. Author of *Which Way Democracy?;* etc.

**W. P. C.**—William Pitcher Creager. Consulting hydraulic engineer. Author of *Engineering for Masonry Dams;* etc.

**W. P. F.**—William Preston Few. President of Duke University, Durham, N.C, 1924–40

**W. P. G.**—William Percival Grieve. Barrister-at-Law of the Middle Temple, London, and the Midland Circuit.

**W. P. J.**—William Price James. High Bailiff of County Courts, Cardiff, Wales. Author of *Romantic Professions;* etc.

**W. P. Ma.**—Walter P. Marshall. President, the Western Union Telegraph Company, New York, N.Y.

**W. Po.**—(Frederick) Wilson Popenoe. Director, Escuela Agricola Panamericana, Tegucigalpa, Honduras, C A. Collaborator, Office of Foreign Agricultural Relations, U.S Department of Agriculture Author of *Manual of Tropical and Subtropical Fruits.*

**W. P. P.**—W. P. Pycraft. Former Assistant Keeper in Charge of Osteological Collections, British Museum (Natural History), London. Author of *A History of Birds;* etc.

**W. P. R.**—Wilds Preston Richardson. Colonel, U. S. Army. Author of *Reports of Alaska Road Commission;* etc.

**W. P. Re.**—Hon. William Pember Reeves. Director, London School of Economics, 1908–19. Agent-General and High Commissioner for New Zealand, 1896–1908. Author of *State Experiments in Australia and New Zealand.*

**W. P. T.**—William Peterfield Trent. Former Professor of English Literature, Columbia University, New York, N.Y. Author of *English Culture in Virginia;* etc.

**W. P. W.**—W. Porter Ware. Director of Public Relations, University of the South, Sewanee, Tenn.

**W. P. Wb.**—Walter Prescott Webb. Professor of History, University of Texas, Austin, Tex. Author of *The Great Frontier; The Great Plains.*

**W. Py.—William Peery.** Associate Professor of English, University of Texas, Austin, Tex. Editor of *The Plays of Nathan Field*

**W. R.—William Ripper.** Former Professor of Engineering, University of Sheffield, England Former Chairman, Joint Advisory Council of the Sheffield Trades Technical Societies.

**W. Ra.—William Ratner.** Of the *Newark Evening News* (N J ).

**W. R. B.—Rt. Rev. William R. Brownlow, D.D.** Former Roman Catholic Bishop of Clifton Provost and Domestic Prelate to Pope Leo XIII. Co-editor of *English Roma Sotterranea*

**W. R. Be.—William Rose Benét.** Contributing Editor of the *Saturday Review of Literature,* 1929–50 Awarded Pulitzer Prize for Poetry, 1942.

**W. R. By.—William R. Barclay, M.D.** Instructor, Department of Medicine, The University of Chicago.

**W. R. Ce.—Wesley R. Coe.** Emeritus Professor of Biology, Yale University.

**W. R. D.—Warren Royal Dawson.** Honorary Member of the Egypt Exploration Society.

**W. R. Fe.—William R. Forsythe.** Physical chemist.

**W. R. G.—William R. George.** Founder and former Director of National Association of Junior Republics. Author of *The Junior Republic;* etc.

**W. R. Gs.—William Robert Geddes.** Senior Lecturer in Social Anthropology, Auckland University College, Auckland, N Z. Author of *Deuba: a Study of a Fijian Village; The Land Dayaks of Sarawak.*

**W. R. H.—Sir William Reginald Halliday.** Principal of King's College, London. Member of the Court of the University of London. Rathbone Professor of Ancient History in the University of Liverpool, 1914–28. Author of *[illegible] and Modern;* etc.

**Wr. H. B.—Walter H. Brill, Jr., M.D.** Assistant in Medicine and Physician in the Student Health Service, The University of Chicago.

**W. R. Ho.—William R. Hodgkinson.** Former Professor of Chemistry and Metallurgy, Artillery College, Woolwich, and Principal Demonstrator in Chemistry at Royal College of Science Co-author of Valentine-Hodgkinson's *Practical Chemistry;* etc.

**W. R. I.—Very Rev. William Ralph Inge, D.D.** Dean of St. Paul's 1911–34; Romanes and Hibbert Lecturer, 1920; Lady Margaret Professor of Divinity and Fellow of Jesus College, Cambridge, 1907–11 Gifford Lecturer, St. Andrews, 1917–18 Author of *Lay Thoughts of a Dean; The Philosophy of Plotinus;* etc.

**W. R. L.—William Raymond Longley.** James E. English Professor of Mathematics, Yale University, and Associate Fellow of Trumbull College, Yale

**W. R. Le.—William Richard Lethaby.** Former Professor of Design at the Royal College of Art, South Kensington; former Principal of the London County Council Central School of Arts and Crafts. Author of *Mediaeval Art;* etc.

**W. R. Li.—W. Robert Liefmann.** Former Professor of Economics and Finance, University of Freiburg in Breslau, Germany. Author of *Kartel and Trusts.*

**W. R. M.—Very Rev. Walter Robert Matthews, D.D** Dean of St Paul's, 1934– Fellow of King's College, London, and Member of Senate, University of London Dean of King's College, London, 1918–32. Professor of the Philosophy of Religion, King's College, 1918–[illegible] King 1923–31 Author of [illegible] *Philosophy,* etc

**W. R. M. L.—Sir Walter Rangeley Maitland Lamb.** Secretary of the Royal Academy of Arts, 1913–51.

**W. R. Mo.—William Richard Morfill.** Former Professor of Russian and Other Slavonic Languages in Oxford University and Curator of the Taylorian Institution, Oxford. Author of *Russia;* etc

**W. Rn.—Walter Rosenhain.** Superintendent, Department of Metallurgy [illegible] tional Physical Laboratory, Teddington, England, 1906–31 Author of *Introduction to the Study of Physical Metallurgy.*

**W. Ro.—William Rowan.** Professor of Zoology, University of Alberta, Edmonton, Can. Author of *Riddle of Migration*

**W. R. O.—William R. O'Connor.** Professor of Dogmatic Theology, St Joseph's Seminary, Dunwoodie, Yonkers, N Y Author of *The Layman's Call;* etc

**W. R. P.—Walton R. Patrick.** Professor and Head of the English Department, Alabama Polytechnic Institute, Auburn, Ala Co-editor of *American Short Stories*

**W. R. R.—William R. Redden, M.D.** National Medical Offices, American National Red Cross, Washington, D C

**W. R. S.—William Robertson Smith.** Scottish philologist, physicist, archaeologist, Biblical critic, Editor of the 9th edition of the *Encyclopædia Britannica*

**W. R. Sm.—William Roy Smith.** Former Associate Professor of History, Bryn Mawr College, Bryn Mawr, Pa. Author of *Sectionalism in Pennsylvania during the Revolution.*

**W. R. So.—William Ritchie Sorley.** Knightbridge Professor of Moral Philosophy in Cambridge University, 1900–33 Author of *A History of English Philosophy,* etc

**W. R. Wi.—William Rulon Williamson.** Actuarial Consultant, Washington, D.C.

**W. S.—William Sharp.** Author of volumes of poetical prose under pen name of "Fiona Macleod." Author of biographies of *Dante Gabriel Rossetti; Heine;* etc.

**W. S. A.—Sir Westcott Stile Abell.** Professor of Naval Architecture, Armstrong College, Newcastle upon Tyne, 1928–41. Chief Ship Surveyor, Lloyds Register of Shipping, 1914–28.

**W. S. As.—Walter S. Adams.** Research Associate, Carnegie Institution. Director, Mount Wilson Observatory of the Carnegie Institution of Washington, Pasadena, Calif, 1923–46.

**W. Sc.—Rev. P. Wilhelm Schmidt.** Professor of Ethnology, Fribourg University, Switzerland, and Director, Anthropological Institute.

**W. S. C.—Walter Stanley Campbell.** Pen Name: Stanley Vestal Research Professor, University of Oklahoma, Norman, Okla. Author of *Sitting Bull, Champion of the Sioux; Warpath and Council Fire.*

**W. S. De.—William Smith Denham.** Director of Research, British Silk Research Association, 1921–34.

**W. S. E.—William Snyder Eichelberger.** Professor of Mathematics, United States Navy, 1900–02 Director of the Nautical Almanac, United States Naval Observatory, 1910–29

**W. S. F.—William Scott Farren.** Director, Royal Aircraft [illegible] borough, Hants, England, 1941–45 Lecturer in the Engineering Department, Cambridge University, and at the Royal College of Science, London Director of Technical Development, Ministry of Aircraft Production, 1940–41.

**W. S. Fe.—William Scott Ferguson.** McLean Professor of Ancient and Modern History, Harvard University, 1929–45, Dean of the Faculty of Arts and Sciences, 1939–42 Former President American Historical Association Author of *The Athenian Secretaries;* etc

**W. S. G.—Walter Sherman Gifford.** Chairman of the Board, American Telephone and Telegraph Company, New York, N Y 1948–49 Chairman, Industry Advisory Committee of the Board of War Communications, 1941–47

**W. Sha.—W. Shakespeare.** Former Professor of Singing at Royal Academy of Music and Queen's College, London Author of *Art of Singing,* etc.

**W. S. Hd.—Walter Scott Huxford.** Professor of Physics, Northwestern University, Evanston, Ill.

**W. S. Hi.—Walter Sanders Hiatt.** Newspaper and magazine writer. Former correspondent for Associated Press, Europe and Asia, 1915–28, for other journals, 1937–40

**W. S. Hr.—Walter Samuel Hunter.** Professor of Psychology, Brown University, Providence, R I Author of *General Psychology, Human Behavior.*

**W. S. J.—William Stanley Jevons.** English economist and logician Author of *Theory of Political Economy; The Principles of Science.*

**W. S. L.—W. S. Lewis.** Professor of Geography, University College, Exeter, Eng

**W. S. L.-B.—Walter Sydney Lazarus-Barlow, M.D.** Former Member of Cancer Committee, Ministry of Health, former Professor of Experimental Pathology, Middlesex Hospital Medical School, University of London. Author of *A Manual of General Pathology;* etc.

**W. S. M.—Walter S. McCellan, M.D.** Medical Director, Saratoga Spa, Saratoga Springs Commission, Saratoga Springs, N Y. Associate Professor of Medicine, Albany Medical College, Albany, N Y.

**W. S. McC.—William S. McCann, M.D.** Dewey Professor of Medicine, University of Rochester, Rochester, N.Y. Physician in Chief, Strong Memorial and Rochester Municipal Hospitals, Rochester. Author of *Calorimetry in Medicine.*

**W. S. Ro.—William Spence Robertson.** Emeritus Professor and Head of Department of History in the University of Illinois, Urbana, Ill Author of *Rise of the Spanish-American Republics;* etc.

**W. S. S.—William Stanley Sykes, M.D.** Anaesthetist for the General Infirmary, Hospital for Women, St. James' Hospital, and Dewsbury Infirmary, Leeds, England

**W. S. Sn.—W. Stuart Symington.** Secretary, U.S. Department of the Air Force, Washington, D.C., 1947–50.

**W. Sta.—William Staniar.** Mechanical Power Engineer and Division Head, Manufacturing Division, Dupont Engineering Company, Wilmington, Del. Author of *Mechanical Power Transmission.*

**W. St.—W. Stormont.** Major Manager, Compagnia Italiana Turismo (Italian State Railways), Official Agency and Steamship Lines.

**W. S. To.—Walter S. Tower.** President, American Iron and Steel Institute, New York, N.Y.

**W. Sw.—Wolfgang Stechow.** Professor of Fine Arts, Oberlin College, Oberlin, O. Author of *Apollo und Daphne; Salomon van Ruysdael.*

**W. S. W.—William S. Williams.** Superintendent of Engineering, J. A. Fay and Egan Company, Cincinnati, O.

**W. S. Wa.—William Stewart Wallace.** Librarian, University of Toronto, Canada. Honorary Editor, Royal Society of Canada. Author of *A History of the Canadian People;* etc.

**W. T. C.—William Thomas Calman.** Keeper of the Department of Zoology, British Museum, London, 1927–36.

**W. Th.—William Thalbitzer.** Professor of Eskimo Language and Culture, University of Copenhagen, 1920–45. Author of *Phonetic Study of the Eskimo Language.*

**W. Tho.—Wallace Thompson.** Former Editor in Chief of *Ingeniería Internacional,* New York, N.Y. Author of *The People of Mexico;* etc.

**W. T. I.—William Thorton Innes.** Founder and Director, Typothetae Printing Trade School, Philadelphia, Pa. Author of *Contributions on Photo-Engraving.*

**W. T. M.—Rt. Rev. William Thomas Manning, D.D.** Bishop of New York, 1921–46.

**W. T. M. F.—William T. M. Forbes.** Assistant Professor of Entomology, New York State College of Agriculture, Cornell University Agricultural Station, Ithaca, N.Y. Author of *The Lepidoptera of New York and Neighboring States.*

**W. T. R. F.—William T. R. Fox.** Professor of International Relations, Columbia University, New York, N.Y. Managing Editor, *World Politics.* Author of *The Super-Powers.*

**W. Ts.—William Thomas.** Chief Inspector of Schools for Wales.

**W. T. Sa.—W. T. Saxton.** Lecturer on Botany, University of Reading, England.

**W. T. T.—William Tatem Tilden, Jr.** Three times World Champion of Tennis; seven times U.S. Champion. Author of *Art of Lawn Tennis;* etc.

**W. Tu.—Worth Tuttle.** Writer.

**W. T. W.—William Templeton Waugh.** Kingsford Professor of History and Chairman of the Department of History, McGill University, Montreal, Canada, 1925–32. Author of *The Monarchy and the People;* etc.

**W. T. Ws.—William Thomas Wells.** Barrister-at-Law. Member of Parliament for Walsall, Eng., 1945– . General Staff Officer, 2nd Grade, Directorate of Military Training, War Office, London, 1942–45. Author of *How English Law Works;* etc.

**W. V. B.—Sir William Valentine Ball.** Master of the Supreme Court, King's Bench Division, 1921–43; Senior Master and King's Remembrancer 1943–47. Author of *Bankruptcy, Deeds of Arrangement and Bills of Sale;* etc.

**W. v. Bud.—Wolfgang von Buddenbrock-Hettersdorf.** Professor of Zoology, University of Kiel, Germany. Director of the Zoological Institute and Museum, Kiel.

**W. V. H.—William Vermillion Houston.** President, Rice Institute, Houston, Tex. Professor of Physics, California Institute of Technology, Pasadena, Calif., 1931–46. Author of *Principles of Mathematical Physics.*

**W. V. M.—William V. Morgenstern.** Director of Public Relations, The University of Chicago.

**W. V. Q.—Willard Van Orman Quine.** Professor of Philosophy, Harvard University. Author of *Elementary Logic; Mathematical Logic;* etc.

**W. W.—Williston Walker, D.D.** Former Professor of Church History, Yale University. Author of *History of the Congregational Churches in the United States;* etc.

**W. Wa.—William Wardlaw.** Professor of Physical Chemistry, Birkbeck College, University of London. Secretary of the Chemical Society.

**W. Wal.—William Wallace.** Former Fellow and Librarian of Merton College, Oxford, and Whyte Professor of Moral Philosophy. Author of *The Logic of Hegel; Kant;* etc.

**W. W. Ch.—Winn W. Chase.** Associate Editor of *Textile World.*

**W. W. D.—Werner Wilfred Duecker.** Manager, Research Department, Texas Gulf Sulphur Company, Inc., New York, N.Y.

**W. W. F.—W. Warde Fowler.** Gifford Lecturer, Edinburgh University, Scotland, 1908. Former Fellow of Lincoln College, Oxford. Author of *The City State of the Greeks and Romans;* etc.

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FOR IDENTIFICATION OF CONTRIBUTORS BY INITIALS SEE PAGE XI

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**Abbott, Grace.** Child Welfare and Child Labour (*in part*)
**Abbott, Yarnall.** Landscape Painting (*in part*); Tempera
**Abel, Barbara.** Community Chest
**Abell, Sir Westcott Stile.** Shipbuilding: Mercantile; Shipping: Registration, Classification and State Regulation, Shipping: Tonnage Terms
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**Ackerman, Phyllis.** Asia (*in part*); Persia (*in part*); Rope and Ropemaking (*in part*); Tapestry
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**Adams, Charles Dennis.** Gold Coast (*in part*)
**Adams, Frederick J.** Garden Cities (*in part*)
**Adams, George Burton.** Feudalism (*in part*)
**Adams, James Luther.** Christian Socialism
**Adams, James T.** Massachusetts (*in part*)
**Adams, Thomas.** Zoning
**Adams, Walter S.** Observatory (Astronomical) (*in part*)
**Adamson, Robert.** Bacon, Francis (*in part*); Berkeley, George (*in part*); Kantian Philosophy; Schelling, Friedrich Wilhelm Joseph von (*in part*)
**Addinall, Carl R.** Pyrimidines
**Addison, Major General George Henry.** Engineers, Military (*in part*)
**Adler, Hans A.** Deutsche Bank; Deutscher Länder, Bank; Dresdner Bank
**Adnan, A. A.** Turkey (*in part*)
**Adrian, E. D., M D** Chronaxie; Equilibrium, Animal; Nerve (*in part*)
**Adrian, Gilbert.** Dress (*in part*)
**Ady, Cecilia Mary.** Italy (*in part*)
**Affleck, Benjamin Franklin.** Atlas Portland Cement Company
**Agger, Eugene E.** Money Market (*in part*)
**Agnew, Hugh E.** Advertising (*in part*), American Association of Advertising Agencies; American Newspaper Publishers' Association; Brands; Price-Cutting (*in part*)
**Agresti, Olivia Rossetti.** Mafia (*in part*); Naples, Bank of
**Ahlberg, Hakon.** Modern Architecture, 18th and 19th Centuries (*in part*)
**Ahmad, Abul Faiz Ziauddin.** Arbitration (*in part*)
**Ahmad, Kazi S.-ud-D.** Baluchistan; Bolan Pass
**Aiken, Wellington E.** Vermont (*in part*)
**Ainger, Alfred.** Lamb, Charles (*in part*)
**Ainslie, Rev. Peter, D.D.** Christian Unity; Disciples of Christ or Christians
**Airy, Osmund.** Sidney, Algernon (*in part*)
**Aitken, W. A., D.V M.** Veterinary Science (*in part*)
**Albee, Edward F.** Vaudeville
**Albert, A. Adrian.** Determinant; Fields; Groups; Linear Algebras; Quasi-Groups; Quaternions
**Albion, Robert Greenhalgh.** Government Departments (*in part*)
**Albright, William F.** Palestine (*in part*)
**Alden, Sir Percy.** Elberfeld Poor Relief System; Vagrancy (*in part*)
**Alexander, Albert Ernest.** Colloids (*in part*); Dialysis
**Alexander, Horace Gurney.** Gandhi, Mohandas Karamchand
**Alexander, J. W.** Knots; Manifolds
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**Alexander, Samuel.** Qualities
**Allan, John.** Numismatics (*in part*); Sanskrit Language and Literature (*in part*)
**Allee, W. C.** Animal Behaviour; Animal Sociology; Distribution of Animals (*in part*); Tropism
**Allemes, Frederick.** French Law and Institutions (*in part*)
**Allen, Arthur A.** Birds (*in part*); Song Birds (*in part*)
**Allen, Basil E.** Lead in Art
**Allen, Bennet M.** Metamorphosis (*in part*)
**Allen, Edward W.** Fisheries, Law of (*in part*)
**Allen, Frederick Harold, M D.** Psychiatry (*in part*)
**Allen, Gay Wilson.** Caesura
**Allen, George C.** Hollow-ware
**Allen, Oswald C.** Employment Exchange (*in part*)
**Allen, Roy George Douglas.** Prices, Statistics of (*in part*)
**Allen, Victor Thomas.** Bentonite; Diatomaceous Earth; Fuller's Earth (*in part*)
**Allister, Ray.** Friese-Greene, William
**Allred, C. E.** Tennessee
**Alphandery, Paul Daniel.** Humiliati; Inquisition, The (*in part*)
**Altham, Captain Edward.** Admiralty; Anchor; Battle (*in part*), Beatty, David; Capstan; China (*in part*); Coronel, Battle of, Fleet, Naval (*in part*), Jellicoe, John Rushworth Jellicoe (*in part*), Jutland, Battle of, Log, Maritime; Midshipman (*in part*), Navy and Navies; Quartermaster (*in part*), Rule of the Road at Sea; Scapa Flow; Seamanship, Ship (*in part*); Staff, Naval (*in part*); Wilson, Sir Arthur Knyvet
**Altham, H. S.** Cricket
**Altmeyer, Arthur J.** Social Security (*in part*)
**Ambler, Charles Henry.** West Virginia
**Amick, Charles L.** Illuminating Engineering; Illumination, Industrial Illumination (*in part*)
**Amos, Sir Maurice S.** Code Napoléon (*in part*)
**Anchel, Robert.** Marat, Jean Paul, Vendee, Wars of The
**Anderson, Arthur D.** Boot and Shoe Machinery (*in part*)
**Anderson, David.** Bridges (*in part*); Tunnel (*in part*)
**Anderson, Ernest.** Algin; Gums, Plant
**Anderson, Ira D.** Marketing
**Anderson, Sir John.** Shipping, Ministry of
**Anderson, Nels.** Vagrancy (*in part*)
**Anderson, Roger Charles.** Ship (*in part*)
**Anderson, Rudolph M.** Fur-Bearing Animals (Land)
**Anderson, Thomas Joel, Jr.** Trusts (*in part*)
**Anderson, Colonel William Patrick.** St. Lawrence
**Andrade, Edward Neville da Costa.** Arrhenius, Svante August, Barometric Light, Interferometer (*in part*), Michelson-Morley Experiment; Perpetual Motion (*in part*); Physics, Articles on; Radiation Rays (*in part*); Raman Effect; Resonance Potentials; Transmutation of the Elements; Vacuum (*in part*); Wilson Cloud Chamber (*in part*)
**Andrews, Andrew I.** Porcelain Enamelling
**Andrews, Donald Hatch.** Heat (*in part*), Latent Heat
**Andrews, Rev. Herbert Thomas, D.D.** Logia (*in part*), Polycarp (*in part*)
**Andrews, Brigadier General Lincoln Clark.** Bootlegging
**Andrews, Mildred Gwinn Barnwell.** Cotton and the Cotton Industry (*in part*); Cotton Waste; Synthetic Fibres (*in part*)
**Andrews, Roy Chapman.** Mongolia (*in part*)
**Andrus, J. Russell.** Bangkok; Cambodia (*in part*); Cochin-China; Havoi; Hué; Laos; Luang-Prabang; Patani
**Angell, Sir Norman.** Outlawry of War
**Annan, Noel Gilroy.** Strachey, Giles Lytton
**Anrep, Gleb von.** Vascular System
**Anslinger, Harry J.** Drug Addiction (*in part*); Opium Traffic (*in part*)

**Anthony, Joseph.** Public Relations
**Antrobus, Sir Reginald.** St. Helena (*in part*)
**Anttila, Aarne Armas.** Finnish Literature (*in part*)
**Appleman, John Alan.** Motor Vehicle Insurance (*in part*)
**Applemen, Milo Don.** Soil (*in part*)
**Appleton, Sir Edward Victor.** Wireless Telegraphy (*in part*)
**Apter, Nathaniel S.,** M.D. Neurasthenia
**Archer, Thomas Andrew.** Ursula, St (*in part*)
**Archibald, Raymond Clare.** Curves, Special (*in part*); Hodograph; Peirce, Benjamin
**Arden-Close, Colonel Sir Charles Frederick.** Map (*in part*), Surveying (*in part*)
**Argo, Mary Langs.** Nucleus (*in part*)
**Arkell, Anthony J.** Baggara; Bertat, Hameg; Jur; Nubia (*in part*); Sudan, Anglo-Egyptian (*in part*)
**Armentrout, Winfield Dockery.** Consolidated School (*in part*), Rural Education (*in part*)
**Armstrong, Charles Arthur John.** Germany (*in part*), Warwick, Richard Neville
**Armstrong, Edward.** Charles V
**Armstrong, Major General George E., M.D.** Medical Service, Army
**Armstrong, Harry G., M.D.** Aviation, Medical Aspects of
**Armstrong, T. E.** Buriat; Koryaks
**Armstrong, Walter Gordon.** Pressed Metal
**Armstrong, W. E.** Clan, Family (*in part*), New Guinea (*in part*); Oceania (*in part*); Totemism
**Arndt, Heinz Wolfgang.** Australia (*in part*)
**Arnett, A. M.** Jay, John, Pierce, Franklin; Sheridan, Philip Henry
**Arnold, Guy L.** Aerial Navigation
**Arnold, Henry H.** Air Warfare (*in part*)
**Arnold, J. H.** Westminster Bank Limited
**Arnold, Robert Franz.** Austrian Literature
**Arnold, Sir Thomas Walker,** Arabic Language; Islam; Miniature Painting (*in part*)
**Arthur, John Morris.** Climate, Artificial
**Arup, Erik.** Denmark (*in part*)
**Asdell, S. A.** Gestation Periods
**Ashby, Arthur Wilfred.** Land Nationalization
**Ashby, Thomas.** Agrigentum (*in part*); Apennines (*in part*); Callicula; Cannae; Clusium; Ferentino; Flaminia, Via; Fondi; Frascati; Friuli; Gabii; Gaeta; Gela; Grottaferrata; Halaesa; Hispellum; Ischia (*in part*), Italy (*in part*); Lavinium; Leghorn (*in part*); Locri; Loreto; Lucania (*in part*); Lucca; Magna Graecia; Megara Hyblaea; Messina (*in part*); Metaurus, Monreale (*in part*), Nola; Orvieto Osta; Paestum, Pantelleria (*in part*), Pavia (*in part*) Perugia; Pisa (*in part*); Pompeii (*in part*), Praeneste (*in part*); Puteoli; Ravenna (*in part*); Sardinia (*in part*); Segesta; Setia; Siena (*in part*); Spoleto; Subiaco; Sulci; Sutri; Syracuse (Sicily) (*in part*), Taranto; Terracina; Tivoli (*in part*); Trasimenus, Lake; Trebia, Turin (*in part*); Tuscany (*in part*), Tusculum, Tyndaris; Umbria; Veii, Velletri, Venetia (*in part*); Vercelli, Verona (*in part*); Vesuvius (*in part*); Vibo Valentia; Vicenza; Viterbo; Volterra
**Ashby, Wallace.** Farm Buildings
**Ashton, Edmund Hugh.** Basutoland
**Asmous, Vladimir C.** Engler, Heinrich Gustav Adolf; Jung, Joachim; Senebier, Jean
**Aston, Francis William.** Isotopes (*in part*); Positive Rays
**Aston, Major General Sir George (Grey).** Abyssinia (*in part*); China (*in part*); Estonia (*in part*); Great Britain (*in part*); Nigeria (*in part*), Palestine (*in part*)
**Atherton, Gertrude Franklin.** Rezánov, Nicolai Petrovich de
**Atkins, E. A.** Barbed Wire; Galvanized Iron and Steel (*in part*): Wire (*in part*); Wire Manufactures; Wire Springs (*in part*)
**Atkinson, B. F. C.** Achaens; Alphabet; Dorians; Ionians; Leleges; Pelasgians; and Articles on the following letters of the Alphabet: A; H (*in part*), I; K to Z
**Atkinson, Charles Francis.** Austrian Succession, War of The (*in part*); Castle (*in part*); Dutch Wars (*in part*); Franco-German War (*in part*), French Revolutionary Wars (*in part*); Grand Alliance, War of The (*in part*); Grant, Ulysses Simpson (*in part*), Great Rebellion, Long Island (*in part*), Rossbach, South African War, 1899–1902 (*in part*); Thirty Years' War (*in part*), Turenne, Henri de La Tour D'Auvergne, Vicomte de, Wilderness (*in part*)
**Atkinson, G. T.** Fish Curing (*in part*)
**Atkinson, Richard John Copland** Stonehenge
**Atkinson, William Christopher.** [illegible] (*in part*), Novel (*in part*), Olivares, Gaspar de Guyman; Spain (*in part*), Spanish Language, Spanish Literature
**Atteridge, A. Hilliard.** Germany (*in part*)
**Atwood, Harrison.** Merchandise Marks (*in part*)
**Atwood, John Murray,** D D. Universalist Church
**Aubrey-Fletcher, Major Sir Henry Lancelot.** Barrosa, Battle of, 1811; Ciudad Rodrigo (*in part*), Corunna (*in part*), Toulouse (*in part*)
**Auchincloss, James Coats.** Frauds (*in part*)
**Audrieth, Ludwig Frederick.** Ammonia; Hydrazine, Hydroxylamine, Nitrides
**Austin, C. M.** Pilotage Laws (*in part*)
**Austin, Mary Hunter.** Amerind Folklore
**Auty, Robert.** Czech Language and Literature (*in part*)
**Avery, Sewell Lee.** Montgomery Ward and Co , Inc (*in part*)
**Axelson, Edward W.** Bridging, Military (*in part*)
**Axon, William E. A.** Manchester (*in part*)
**Ayers, William L.** Bank for Reconstruction and Development, International
**Ayres, Leonard P.** Community Foundation (*in part*)

**Baab, Otto J.** Tetragrammaton
**Babelon, Jean.** [illegible] (*in part*)
**Bach, George L.** Inflation and [illegible]
**Bacher, William.** Gamaliel (*in part*)
**Back, Major General George I.** Signal Communication
**Backus, Standish.** Burroughs Adding Machine Company
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**Bacon, Elizabeth.** Asia (*in part*)
**Badeff, J.** Bulgarian Literature (*in part*)
**Baden-Powell, Major Baden Fletcher Smyth.** Kite-Flying (*in part*)
**Baden-Powell of Gilwell, 1st Baron, Lieutenant General Sir Robert (Stephenson Smyth) Baden-Powell.** Boy Scouts (*in part*)
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**Bailar, John Christian, Jr.** Alum (*in part*); Coordination Compounds
**Bailey, Cyril.** Roman Religion
**Bailey, Sir Edward B.** Scotland (*in part*)
**Bailey, Henry T.** Art Teaching (*in part*)
**Bailey, Liberty Hyde.** Palm (*in part*)
**Baillie, Hugh.** United Press Associations (*in part*)
**Baillie, Sir J. B.** Hegelian Philosophy (*in part*)
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**Baker, Carlos.** Hemingway, Ernest (Miller)
**Baker, Charles H. Collins.** Dobson, William; Droeshout, Martin; Faithorne, William, Hilliard, Lawrence; Merian, Matthaus, Oliver, Isaac Peter
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**Baker, Edwin S.** Lawn Tennis and Tennis (*in part*)
**Baker, Ernest A.** Trollope, Anthony
**Baker, James A.,** D V M. Rinderpest (*in part*)
**Baker, Sidney J.** Pidgin English; Slang (*in part*)
**Baker, S. Josephine,** M D. Nursery Equipment
**Baker, S. L.** Incubators (*in part*)
**Baker, Thomas.** Crucible Cast Steel; Furnace, Metallurgical
**Bald, Robert Cecil.** Great Britain (*in part*)
**Baldwin, Lewis W.** Missouri Pacific Lines
**Balfour, Sir Isaac Bayley,** M.D. Angiosperms (*in part*)
**Balfour-Melville, Evan Whyte Melville.** Malcolm (four Scottish kings); Scotland (*in part*)
**Balk, Robert.** Schists
**Balke, Clarence W.** Carbides; Columbium (*in part*); Molybdenum; Rhenium; Tantalum
**Ball, Sir William.** Appeal (*in part*); Bankruptcy (*in part*); Legal Aid (*in part*); Libel and Slander (*in part*); Practice and Procedure (*in part*); Venue (*in part*)
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**Balleine, George Reginald.** Channel Islands; Jersey
**Balzer, W. H.** Clocks (*in part*)
**Banton, Joab H.** [illegible] (*in part*)
**Banton, Michael Parker.** Krumen
**Barber, Colonel Alvin Barton.** Rule of the Road (*in part*)
**Barber, Eric Arthur.** Catullus, Gaius Valerius
**Barclay, Sir Thomas.** International Law, Public; Pacific Blockade (*in part*)
**Barclay, William R.,** M D. Silicosis
**Barcroft, Sir Joseph,** M D. Anoxaemia; Physiology; Pigments of Skin and Hair; Respiration (*in part*)
**Bard, Philip.** Sea Sickness
**Baring, Wing-Commander Hon. Maurice.** Taine, Hippolyte Adolphe (*in part*)
**Barker, Aldred Farrer.** Alpaca (*in part*); Combing; Felt; Woollen Manufacture; Yarn
**Barker, B. T. P.** Cider (*in part*); Perry
**Barker, Dennis.** Navigation Laws
**Barker, E. Phillips.** Folk-Dancing
**Barker, Sir Ernest.** Aristotle; Aulic Council; Baldwin I (Count of Edessa) (*in part*); Baldwin II (Count of Edessa) (*in part*); Baldwin III; Crusades (*in part*); Diet; Electors (*in part*); Empire; Fulk (*in part*); Imperial Chamber
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**Barman, Christian.** Bridges (*in part*)
**Barnard, Harry Everett.** Flour and Flour Manufacture (*in part*)
**Barnard, Raymond Walter.** Commutative Laws: Exponent; Infinitesimal; Mathematical Induction; Mean (*in part*); Moore, Eliakim Hastings
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**Barnes, Harry Elmer.** Flogging; Prisons (*in part*)
**Barnes, John Arundel.** Kinship
**Barnes, Rev. William Emery,** D.D. Ecclesiasticus

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**Barnett, James H.** Halloween
**Barnhart, Harry.** Community Singing
**Barraclough, Geoffrey.** Electors (*in part*)
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**Barron, Oswald.** Beard. Bill, Cecil (Family); Collar (*in part*); Girdle; Heraldry; Russell (Family)
**Barrows, Alice Prentice.** Platoon School (*in part*)
**Bartelmez, George William.** Menstruation; Reproductive System (*in part*)
**Bartleet, H. W.** Cycling (*in part*)
**Bartlett, Frederic Charles.** Experimental Psychology
**Bartlett, James.** Carpentry; Masonry
**Bartlett, James Vernon, D D.** Acts of the Apostles. Barnabas, Barnabas, Epistle of; Frommel, Gaston; Hebrews, Epistle to the; Luke (*in part*), Mark, St.; Paul, Stephen, Vinet, Alexandre Rodolphe
**Bartley, S. Howard.** Vision or Sight
**Bartoli, Adolfo.** Italian Literature (*in part*)
**Barton, Roger Avery.** Advertising (*in part*)
**Bartow, Virginia.** Northrop, John Howard; Wallach, Otto
**Baruch, Bernard Mannes.** Raw Materials
**Baswick, George Frederick.** Midhat Pasha
**Bassett, Ralph Henry.** Ceylon (*in part*)
**Bastable, Charles Francis.** Bimetallism (*in part*), Decimal Coinage
**Bastin, Edson Sunderland.** Penrose, Richard Alexander Fullerton, Jr.
**Batchelor, Leon Dexter.** Citrange, Citron; Grapefruit; Lemon; Lime; Orange; Shaddock
**Bateman, Harry.** Dynamics; Elasticity; Hydromechanics
**Bates, Esther Willard.** Pageant (*in part*)
**Bates, Ralph Samuel.** Chemical Societies
**Bather, Francis Arthur.** Echinoderma (*in part*); Sea-Urchin (*in part*)
**Batten, A. G. M.** Accident Insurance, Personal (*in part*); Engineering Insurance (*in part*)
**Battle, George Gordon.** Women, Legal Position of
**Bauer, Catherine.** Housing (*in part*)
**Bauer, Frederick Charles.** Catch-Crops; Rotation of Crops; Soil (*in part*)
**Bauer, Norman.** Refractometer
**Baufre, William L. de.** Steam Generation (*in part*)
**Baughman, Urbanus Edmund.** Secret Service, U.S
**Baumeister, Theodore.** Boilers
**Baumer, William H.** Fortification; Infantry (*in part*); Officers; Staff, Military; Strategy
**Baumgarten, E. H.** Bowling
**Bax, Admiral Robert Nesham.** Convoy; Submarine Campaigns (World Wars I and II) (*in part*)
**Baxandall, David.** Calculating Machines (*in part*); Ellipsographs; Graduation
**Baxter, Dow Vawter.** Arboriculture
**Baxter, Gregory Paul.** Atom (*in part*)
**Bay, Emmet Blackburn, M D.** Arteries, Diseases of, Heart, Diseases of the
**Bayles, B. B.** Cereals (*in part*)
**Baylis, Harry Arnold.** Platyhelminthes or Platodaria (*in part*); Tapeworms (*in part*); Trematodes (*in part*), Turbellaria (*in part*)
**Beach, Frank A.** Play in Animals, Sexual Behaviour
**Beal, John Mann.** Bermuda Grass; Bird-of-Paradise Flower; Bolivia (*in part*), Bottle-Brush Plants, Bougainvillea; Cercidiphyllum; Gas Plant; Heterogamy; Hydrophyllaceae
**Bealby, John Thomas.** Syr-Darya (*in part*)
**Beale, Joseph Henry.** International Law, Private (*in part*)
**Bealer, Lewis W.** Amazonas; Ancash; Argentina (*in part*); Bolivia (*in part*); Brazil (*in part*), British Honduras (*in part*); Callao (*in part*); Colombia (*in part*); Costa Rica (*in part*); Ecuador (*in part*); Guadeloupe; Guatemala (*in part*), Honduras (*in part*); Loreto, Madre de Dios, Martinique; Nicaragua (*in part*), Panamá (country) (*in part*); Paraguay (*in part*), St Eustatius and Saba; St Kitts or St. Christopher, St Lucia, St. Vincent, Salvador, El (*in part*), San Martin, Tobago; Trinidad, Trujillo (*in part*), Tumbes, Turks and Caicos Islands, Uruguay (*in part*); West Indies, The (*in part*); Windward Islands
**Beals, Carleton.** Mexico (*in part*)
**Beams, Jesse Wakefield.** Velocity of Light (*in part*)
**Bean, Walton E.** America (*in part*)
**Bear, Donald.** Painting (*in part*)
**Bearce, H. W.** Jolly Balance
**Beardsley, A. P.** Ultramarine
**Beardsley, Neil Freeborn.** Lantern
**Bearn, J. Gould.** Distemper (*in part*), Luminous Paint, Paint (*in part*); Painter-Work in the Building Trade
**Beaton, A. C.** Kassala
**Beattie, James Alexander.** Water
**Beaujon, Paul.** Books (*in part*)
**Beaumont, Charles-Louis de.** Cane Fencing
**Beazley, Sir Charles Raymond.** Andrew of Longjumeau, Cam (Cão) Diogo, Chang Chun, Kiu, Columbus, Christopher (*in part*); Cook, James, Dampier, William, Davis or Davys, John, Hayton; Idrisi, Leif Ericsson, Monte Corvino, Giovanni di, Neckam, Alexander (*in part*), Ptolemy (*in part*); Thorfinn Karlsefni, Varthema (Barthema Vertomannus), Ludovico di; Vespucci, Amerigo; Zemarchus
**Beck, Alfred Charles, M D** Birth (Labour, Parturition)
**Beck, Bertram Maurice.** Juvenile Delinquency (*in part*)
**Beck, Frederick George Meeson.** Aethelred; Deira, East Anglia; Edwin, Essex, Kingdom of, Goths (*in part*), Hwicce, Kent, Lombards or Langobardi (*in part*); Lothian, Mercia; Northumbria; Saxons; Strathclyde, Sussex, Kingdom of; Vandals (*in part*), Wessex (*in part*)
**Beck, Horace.** Beads
**Beck, Norman Wood.** New Jersey
**Becke, Archibald Frank.** Waterloo Campaign, 1815
**Beebe, William.** Galápagos Islands (*in part*)
**Beebe-Center, John G.** Feeling, Psychology of
**Beekley, John Sherman.** Urea or Carbamide
**Beer, Gavin Rylands de.** Caenogenesis
**Behar, M. F.** Regulation, Automatic
**Behre, Charles H., Jr.** Ore Deposits
**Bell, Aubrey Fitzgerald.** Camoens (Camões), Luis de, Garrett, João Baptista da Silva Leitão de Almeida (*in part*); Gibraltar (*in part*); Goes, Damião de (*in part*); Herculano de Carvalho E Araujo, Alexandre (*in part*); Lopes, Fernao (*in part*); Manuel de Mello, Dom Francisco (*in part*); Portuguese Literature (*in part*); Vincente, Gil
**Bell, Sir Charles Alfred.** Tibet (*in part*)
**Bell, Elexious Thompson, M D** Purpura; Ulcer
**Bell, E. T.** Abel, Niels Henrik; Bolyai, Johann; Bolyai, Wolfgang; Dedekind, Julius Wilhelm Richard: Equations, Theory of; Fermat, Pierre, Fredholm, Erik Ivar; Frobenius, Ferdinand Georg; Galois, Évariste; Gauss, Karl Friedrich; Hermite, Charles, Hesse, Ludwig Otto; Hilbert, David; Kummer, Ernst Eduard; Liouville, Joseph, Picard, Charles Émile
**Bell, Rt. Rev. George K. A., D D.** Davidson of Lambeth, Randall Thomas Davidson
**Bell, Gertrude.** Druses (*in part*)
**Bell, Sir Harold Idris.** Palaeography (*in part*)
**Bell, Joseph N.** Concrete (*in part*)
**Bell, Walter George.** Barnet (*in part*); Bosworth Field, Battle of; London (*in part*); Tewkesbury (*in part*)
**Bellamy, John Cary.** Altimetry
**Bellamy, Paul.** Cleveland; Ohio (*in part*)
**Bellot, Hugh Hale Leigh.** Age; "Alabama" Arbitration; Alien (*in part*); Allegiance (*in part*); Amnesty; Angary, Right of, Betterment; Blasphemy; Blockade (*in part*); Common Pleas, Court of, Compensation (*in part*), Conquest, Contraband, Declaration of Paris, Drago Doctrine, Embargo; Exterritoriality, Inns of Court and Chancery (*in part*), Justiciarius Capitalis Anglie, King's Bench, Court of, Lord Chancellor, Master of the Rolls; Precedent (*in part*), Pacific Blockade (*in part*), University Courts
**Beloff, Max.** Russia (*in part*)
**Bémont, Charles.** Baluze, Étienne; Béarn; Chronicle
**Bender, Harold H.** Geiger, Wilhelm
**Benedetti-Pichler, Anton Alexander.** Chemistry (*in part*)
**Benedict, Agnes E.** Day Nurseries (*in part*)
**Benedict, Libby.** Rothschild
**Benedikz, Eirikur.** Iceland (*in part*)
**Beneš, Eduard.** Little Entente (*in part*)
**Benét, William Rose.** Dreiser, Theodore; Masters, Edgar Lee (*in part*)
**Bennett, Albert A.** Combinatorial Analysis (*in part*)
**Bennett, Alva Herschel.** Binocular Instrument (*in part*)
**Bennett, Edward E.** Montana (*in part*)
**Bennett, George Allen, M D** Tongue
**Bennett, R. W.** Newark (*in part*)
**Bennett, Wendell Clark.** South America (*in part*)
**Bennett, William Henry D D** Balaam (*in part*)
**Bennion, Charles.** Boot and Shoe Machinery (*in part*)
**Bentley, Wilson Alwyn.** Frost
**Benton, W. A.** Weighing Machines
**Bentwich, Norman de Mattos.** Israel; Zionism (*in part*)
**Benveniste, Emile.** Asianic Languages; Etruscan Language
**Berg, Carl.** Battery (*in part*)
**Berg, Eskil.** Mercury-Vapour Boiler
**Bergen, Edgar John.** Ventriloquism
**Bergenstal, Delbert M., M D.** Animal Extracts
**Berle, Rudolf P.** Conspiracy (*in part*)
**Bernal, John Desmond.** Crystallography (*in part*); X-Rays and Crystal Structure
**Bernard, Augustin.** Morocco (*in part*), Tangier (*in part*), Tripoli, Tripolitania (*in part*); Tlemçen (*in part*)
**Bernewitz, M. W. von.** Prospecting
**Bernstein, Eduard.** Bebel, August (*in part*), Marx, Karl Heinrich (*in part*)
**Bernus, Pierre.** Briand, Aristide; Dreyfus, Alfred, Cachin, Marcel (*in part*); Painlevé, Paul; Poincaré, Raymond; Viviani, René
**Berrill, N. J.** Tunicata
**Berry, Arthur.** Elliptic Functions (*in part*)
**Berry, Arthur John.** Chemistry (*in part*)
**Berry, Sir William John.** Armour Plates; Battleship (*in part*), Shipbuilding
**Bertelli, Riccardo.** Sculpture Technique (*in part*)
**Berulfsen, Bjarne.** Norwegian Language
**Best, B. W.** Bicycle (*in part*)
**Best, Charles Herbert, M D** Diabetes Mellitus (*in part*), Insulin (*in part*)
**Bethe, Hans Albrecht.** Neutron (*in part*)
**Betten, Cornelius.** Trichoptera
**Bettesworth, W. A.** Stoolball
**Bettex, Albert.** Swiss Literature (*in part*)
**Bevan, Edwyn R.** Alexander III ("The Great") (*in part*); Lysimachus, Perdiccas; Philip V; Ptolemies; Seleucid Dynasty (*in part*)
**Bewes, Wyndham A.** Bailiff and Bailie (*in part*); Inheritance (*in part*); Instalment Purchase (*in part*); International Law, Private (*in part*); Trust and Trustees (*in part*)
**Beyer, Richard L.** Hunter, Robert
**Beza, Marcu.** Rumanian Language and Literature (*in part*)
**Bezzant, Rev. Canon James Stanley, B.D.** England, The Church of (*in part*)
**Bhownaggree, Sir Mancherjee Merwanjee.** Patel, Framjee Nasarwanjee (*in part*)
**Bibesco, Prince Antoine.** Rumanian Language and Literature (*in part*)

**Bickley, Francis.** Diplomatic (*in part*)
**Bicknell, Edward John, D D** Athanasius "The Great"
**Bidou, Henri.** Joffre, Joseph Jacques Césaire; Lanrezac, Charles Louis
**Bieler, Ralph Paul.** Missouri (*in part*); St. Louis
**Bigg, Rev. Charles, D D** Philo (*in part*)
**Bigg, Wilfred Joseph.** British Commonwealth (*in part*)
**Biggs, E. Power.** Organ
**Billings, Marland P.** Fault; Folds
**Bills, Arthur Gilbert.** Efficiency, Conditions of; Fatigue (*in part*); Psychology, History of (*in part*)
**Bills, Charles E(verett).** Cod Liver Oil
**Bingham, Howard.** Aerodrome
**Bingham, J. Lyman.** Athletic Sports (*in part*)
**Bingham, Millicent Todd.** Cuzco (*in part*); Ica (*in part*); Lima (city) (*in part*); Peru (*in part*)
**Binkley, Wilfred E.** Wheeler, William Almon
**Binni, Walter.** Drama (*in part*)
**Binnie, William James Eames.** Catchment Areas; Reservoirs
**Binyon, Laurence.** Chinese Painting; Japanese Painting and Prints
**Birch, Francis Lyall.** Great Britain (*in part*); Prime Minister (*in part*), Privy Council
**Birkhoff, Garrett.** Lattice Theory; Mathematics, Foundations of; Number
**Bishop, Carl W.** China (*in part*)
**Bishop, Rev. Herbert Louis.** Angola (*in part*); Portuguese East Africa (*in part*), St Thomas
**Bishop, Joseph Bucklin.** Goethals, George Washington
**Bishop, Lottie Genevieve.** Yale University (*in part*)
**Bishop, William John.** Ranvier, Louis Antoine
**Bissell, Clinton T.** Fireproofing (*in part*)
**Bisset, Charles Barron.** Tanganyika (territory) (*in part*)
**Bisset, John C.** Billiards (*in part*)
**Biswell, Charles Bedford.** Resorcinol
**Black, John D.** Agricultural Wages; Agriculture, Census of
**Black, John Sutherland.** Gibbon, Edward (*in part*); Mazzini, Giuseppe (*in part*)
**Blackman, Vernon Herbert.** Leaf (*in part*); Lianes or Lianas; Palm (*in part*); Pollination
**Blackmore, John.** Latter-Day Saints, Reorganized Church of Jesus Christ of
**Blackwell, Alice Stone.** Stone, Lucy
**Blagden, Charles Otto.** Malay Language (*in part*)
**Blair, Walter.** American Literature
**Blake, Roland P.** Factory Inspection
**Blakemore, Thomas L.** Arbitration (*in part*)
**Blanchard, Arthur A.** Carbonyls, Metal
**Blanchard, Major George Samuel.** Korean War (*in part*)
**Blankenhorn, M. A., M.D.** Sunstroke and Heatstroke
**Blanksten, George I.** Colombia (*in part*); Ecuador (*in part*); Honduras (*in part*); Nicaragua (*in part*); Salvador (*in part*)
**Blauch, Lloyd E.** Land-Grant Colleges and Universities; Universities (*in part*)
**Bleininger, Albert V.** China-Clay (*in part*); Chinaware (*in part*)
**Blennerhassett, William Lewis.** Finland (*in part*), Lapland (*in part*); Lusatia
**Blewett, John Paul.** Amplifiers
**Bliss, Gilbert Ames.** Calculus of Variation
**Bloch, Henry Simon.** Crédit Foncier de France; Land Taxes (*in part*); Leroy-Beaulieu, Pierre Paul
**Block, Burton Peter.** Tin
**Blom, Eric Walter.** Mussorgsky, Modest Petrovich; National Anthems; Opera
**Blondal, Sigfus.** Icelandic Literature (*in part*); Sigurðsson, Jón (*in part*)
**Bloom, Benjamin S.** Examinations (*in part*)
**Bloom, William.** Histology, Microtomy
**Bloomfield, Arthur I.** Bill of Exchange in Practice
**Blowski, A. A.** Sugar (*in part*)
**Blucher, Walter H.** Town and City Planning
**Blumberg, General Sir Herbert Edward.** Marines (*in part*)
**Blumenau, Ralph Isaac.** Liège
**Blunden, Edmund Charles.** English Literature (*in part*)
**Blunt, Charles Jaspar.** Tirah
**Blunt, Herbert W.** Logic, History of (*in part*)
**Blunt, Irene L.** Silk and Sericulture (*in part*); Silk Manufacture (*in part*); Silk Trade
**Boal, A. M.** Admiralty Jurisdiction (*in part*)
**Boas, Frederick S.** Drama (*in part*), English Literature (*in part*); Medwall, Henry
**Bogaars, George Edwin.** Malaya (*in part*)
**Bogner, Walter Francis.** Library Architecture (*in part*); Museum Architecture; Religious and Memorial Architecture (*in part*)
**Böhl, F. M. T., D D** Abraham; Amorites; Canaan, Canaanites (*in part*)
**Bohr, Niels Henrik David.** Atom (*in part*)
**Bolte, Charles L.** Army (*in part*)
**Bond, Donald F.** Bibliography (*in part*)
**Bond, Horatio.** Fire Protection (*in part*) Fire Protection
**Bone, Sir Muirhead.** Dry Point (*in part*)
**Boner, Charles Paul.** Electronic Musical Instruments
**Bonn, Moritz J.** Erzberger, Matthias; Ruhr
**Bonneville, Joseph H.** Acceptance (*in part*); Accrued Dividends, Accrued Interest; Certified Cheque; Commercial Paper (*in part*); Controlling Interest; Joint Account, Kiting Cheques, Margin (*in part*); Panic (*in part*); Promissory Note (*in part*)
**Booker, Harold Scott.** Wages (*in part*)
**Booth, Franklin.** Pen Drawing
**Booth, H. C.** Vacuum Cleaner (*in part*)
**Borah, William Edgar.** Idaho (*in part*)
**Borgese, Giuseppe Antonio.** Italian Literature (*in part*)
**Boring, Edwin Garrigues.** Consciousness; Organic Sensations; Psychology (*in part*); Psychology, History of (*in part*); Psychophysics; Titchener, Edward Bradford; Sensation
**Borley, John Oliver.** Seining, Netting and Trawling; Whale Fisheries
**Born, Lester K.** Archives
**Boswell, A. Bruce.** Czarniecki, Stefan; Czartoryski, Adam Jerzy; Czartoryski, Fryderyk Michal, Kollontaj, Hugo; Poland (*in part*); Poznan or Posen (*in part*)
**Boswell, Percy George H.** Clay (*in part*); Conglomerate; Flint; Greywacke; Itacolumite; Limestone; Sand (*in part*); Sandstone; Sedimentary Rocks
**Boswell, Victor Rickman.** Artichoke; Bean; Beet; Broccoli; Cabbage; Celery; Collards; Cucumber; Eggplant; Endive; Muskmelon; Mustard, Onion (*in part*); Parsley; Parsnip; Pea; Peanut; Pumpkin, Radish; Salsify; Sea-Kale; Shallot; Spinach; Squash; Sweet Potato; Tomato; Turnip (*in part*); Watermelon
**Bouard, A. de.** Palaeography (*in part*)
**Boughton, The Rev. Canon Charles Henry Knowler, B.D.** Bible Societies
**Boulding, Kenneth E.** Futures; Market (*in part*); Wealth and Income, Concepts of
**Bouquet, Alan Coates, D.D.** Conversion (*in part*); Solomon, Odes of
**Bourchier, James David.** Athens (*in part*); Balkan Peninsula (*in part*); Bulgaria (*in part*); Crete (*in part*); Greek Literature (*in part*); Ionian Islands (*in part*); Stambulov, Stefan (*in part*)
**Bourdow, Joseph A.** Tactics (*in part*)
**Bouscaren, Timothy Lincoln.** Index Librorum Prohibitum
**Bousset, Wilhelm, D.Th.** Antichrist
**Boussières, G.** Polonium (*in part*)
**Bouthilet, Lorraine.** Affection
**Boutruche, Robert.** Albret; Bastide
**Bovey, Hon. Wilfrid.** Quebec (*in part*)
**Bowen, E. G.** Wales (*in part*)
**Bowen, Frank C.** Ship (*in part*); Shipping Lines and Groups (*in part*); Shipping Routes
**Bowen, John Poland.** Lighthouses (*in part*)
**Bower, Edward.** British Industries Fair; Exhibitions and Fairs (*in part*)
**Bower, Frederick O.** Pteridophyta (*in part*)
**Bowles, Gordon T.** Japan (*in part*)
**Bowley, Arthur Lyon.** Index Numbers
**Bowley, Marian Ellen Alberta.** Industry and Trade, War Control of (*in part*)
**Bowman, LeRoy E.** Community Centres (*in part*)
**Bown, Ralph.** Broadcasting (*in part*)
**Box, Rev. George Herbert,** Hon D.D. Gamaliel (*in part*); Hezekiah (*in part*), Isaiah, John the Baptist; Jubilee; Libertines, Synagogue of the; Messiah and Messias, Nahum, Passover (*in part*), Pentecost, Pharisees; Sadducees; Shekinah; Tabernacles, Feast of; Urim and Thummim
**Boyajian, Aram.** Transformer (*in part*)
**Boycott, Arthur Edwin, M D** Pathology
**Boyer, Carl Benjamin.** Archibald Pythagoras Clare (*in part*); Lebesgue, Henri Léon; Lipschitz, Rudolph Otto Sigismund; Mathematics, History of
**Bozorth, Richard Milton.** Diamagnetism; Ferromagnetism; Magnetism; Paramagnetism
**Brachet, Jean Louis Auguste, M D** Embryology, Chemical
**Brackenbury, Sir Henry Britten, M.D.** Insect Bites and Stings
**Bradbury, Frederick.** Sheffield Plate
**Brade-Birks, Rev. S. Graham.** Centipede (*in part*)
**Braden, Charles S.** Rosicrucianism
**Bradford, Frederick Charles.** Plant Propagation
**Bradford, Gamaliel.** Webster, Daniel
**Bradford, William Leslie, M.D** Scarlet Fever
**Bradley, Alice.** Cookery (*in part*)
**Bradley, Henry.** Beowulf (*in part*); Heliand (*in part*)
**Bradley, Stanley E., M.D.** Kidney, Diseases of
**Bradley, Wilmot Hyde.** Conrolites (*in part*)
**Bradnock, Frederick William.** Birmingham (*in part*)
**Bradshaw, Harold Chalton.** Roman Architecture (*in part*)
**Bradshaw, Mary N. L.** Roman Architecture (*in part*)
**Bradshaw, Percy V.** Poster (*in part*)
**Brady, Alexander.** Canada (*in part*); Ontario (*in part*)
**Bragdon, Charles Ridgaway.** Varnish
**Brambell, F. W. Rogers.** Balanoglossus; Hemichordata
**Brand, Donald D.** Tarascans
**Brandeis, Elizabeth.** Workmen's Compensation (*in part*)
**Brandenburg, Erich.** Berlin (*in part*); Bülow, Bernhard; Germany (*in part*); Prussia (*in part*); William II
**Brandin, Louis M.** Anglo-Norman Literature; Catalan; Charlemagne Legends; French Language; Provençal Language and Literature (*in part*), Romance Languages; Rumanian Language and Literature (*in part*)
**Brandt, Coenraad Dirk Jan.** Holland (*in part*); Holland, County and Province of (*in part*); Netherlands (*in part*)
**Brandt, William E.** Baseball (*in part*)
**Branford, Victor.** Sociology
**Brangwyn, Sir Frank.** Mural Painting
**Branham, Sara Elizabeth, M.D.** Meningitis
**Brannon, E. M.** Judge Advocate General
**Braun, Joseph H.** Motoring (*in part*)
**Braunholtz, Hermann Justus.** Easter Island (*in part*); Oceania (*in part*)
**Bray, Huly Edwin.** Surplus Property Disposal (U.S.) (*in part*)
**Breasted, James H.** Ikhnaton; Tutenkhamon
**Brecht, Arnold.** Government Departments (*in part*)
**Breck, Eduard.** Kite-Flying (*in part*)
**Breder, C. M., Jr.** Aquarium
**Bredin, G. R. F.** Gezira
**Bredsdorff, Elias Lunn.** Danish Language; Danish Literature; Drama (*in part*)

**Brenier, Henri.** Indo-China, French (*in part*); Morocco (*in part*)
**Brereton, Cloudesley.** Academies (*in part*); Classical Education (*in part*); Education, History of (*in part*); Foreign Languages, Teaching of (*in part*); Oxford University (*in part*); Universities (*in part*)
**Breskin, Charles A.** Bottle Manufacture (*in part*)
**Bressey, Sir Charles Herbert.** Roads and Streets (*in part*)
**Bresson, Marcelle M.** Madagascar (*in part*)
**Breton, Norton.** Silk and Sericulture (*in part*); Silk Manufacture (*in part*)
**Brett, Michael.** Salvage (*in part*)
**Bretz, J Harlen.** Korea (*in part*); United States (of America), The (*in part*), Waterfall
**Brewer, Nathan,** D V M Animal Experimentation; Foot-and-Mouth Disease, Swine Fever (*in part*)
**Brewster, James.** Connecticut (*in part*)
**Bricker, John W.** Taft, Robert Alphonso
**Bridges, Sir Edward Ettingdene.** Bank Holidays; Budget (*in part*); Civil Service (*in part*); Pensions (*in part*)
**Bridgewater, H. M.** Chain Manufacture (*in part*)
**Bridgman, Edward C.** Drawing, Anatomical (*in part*)
**Bridgman, George B.** Drawing, Anatomical (*in part*)
**Bridgman, P. W.** Dimensional Analysis
**Briercliffe, Harold.** Motorcycles (*in part*)
**Briggs, Asa.** Corn Laws (*in part*); Disarmament; Domestic Service (*in part*); English History (*in part*); Hours of Labour (*in part*); Sweating System (*in part*)
**Brill, John L.** Cellophane
**Brill, Walter H., Jr.,** M D. Streptomycin; Terramycin
**Brinckerhoff, A. F.** Landscape Architecture (*in part*)
**Brinckerhoff, Henry M.** Traffic and Traffic Regulations (*in part*)
**Brisby, Liliana McBurney.** Bulgarian Literature (*in part*)
**Briscoe, Herman Thompson.** Barium; Calcium; Strontium
**Bristol, Margaret C.** Charity (*in part*)
**Brock, Alan St. Hill.** Fireworks; Flare
**Brockway, Lawrence Olin.** Electron Diffraction
**Brodd, Lawrence S.** Curling
**Brode, Robert Bigham.** Wilson Cloud Chamber (*in part*)
**Brodie, Bernard.** Pacific, Command of the; Sea Power
**Brodie, Lawrence Sabin.** Compass (*in part*)
**Brodie, Thomas Gregor,** M.D. Muscle, Structure of; Phagocytosis
**Brodribb, Rev. William Jackson.** Tacitus, Cornelius (*in part*)
**Brody, Samuel.** Growth
**Broek, Jan O. M.** Asia (*in part*); Batavia (*in part*); Jambi (*in part*); Java (*in part*); Lampongs (The) (*in part*); Palembang (*in part*)
**Bronfenbrenner, Martin.** Competition in Industry
**Bronson, Dorrance Crawford.** Pensions (*in part*)
**Broodbank, Sir Joseph Guinness.** London (*in part*)
**Brooke, Major General Geoffrey.** Horsemanship and Riding (*in part*)
**Brooke, George Doswell.** New York, Chicago and St Louis Railroad
**Brooke, Squadron Leader J. C.** Seaplane (*in part*)
**Brooks, C. E. P.** Africa (*in part*); Asia (*in part*); Climatic History
**Brooks, R. C.** Baker, Newton Diehl; Progressive Party, U.S (*in part*)
**Brooks, Robert Preston.** Georgia
**Brooks, Van Wyck.** James, Henry; Twain, Mark
**Broome, Dorothy M.** Chamber, The King's; Household, The Royal or Curia Regis; Seals (*in part*)
**Broomhall, G. P.** Grain Production and Trade
**Brosin, Henry W.,** M D Psychosis
**Brouwer, Dirk.** Celestial Mechanics, Trojan Planets
**Brown, A. Curtis.** Royalties
**Brown, Andrew Wilson.** Psychology (*in part*)
**Brown, Arthur C. Barrington.** Joints
**Brown, Arthur E.** Brick (*in part*)
**Brown, Charles E.** Signal Corps, U S , Tanks
**Brown, Charles Reynolds,** D.D. Edwards, Jonathan
**Brown, Frank A., Jr.** Hormones, Invertebrate
**Brown, Sir Frank Herbert.** Halifax, Edward Frederick Lindley Wood, 3rd Viscount (*in part*), Lajpat Rai, Lala, Naidu, Sarojini (*in part*), Nehru, Pandit Motilal, Sankaran Nair, Sir Chettur; Sapru, Sir Tej Bahadur (*in part*), Sastri, V S Srinivasa (*in part*)
**Brown, Frederic K.** Snow-Shoes (*in part*)
**Brown, Harry Gunnison.** Single Tax
**Brown, Horatio Robert Forbes.** Venice (*in part*)
**Brown, Irving.** Gypsies (*in part*)
**Brown, Ivor.** Drama (*in part*)
**Brown, Peter Gordon.** Annuity (*in part*); Expectation of Life; Industrial Insurance (*in part*)
**Brown, Ray E.** Clinic
**Brown, Roland Wilbur.** Eocene and Palaeocene
**Brown, Walter J.** San Francisco (*in part*)
**Brown, William,** M.D. Body and Mind
**Brown, William.** Plants and Plant Science (*in part*)
**Brown, William Adams,** D.D. Fundamentalism
**Brownback, Henry Lowe.** Motor Car (*in part*)
**Browne, Frederick Lincoln.** Casein
**Browne, Harris Warren C.** Printing Type (*in part*)
**Brownell, Emery A.** Legal Aid (*in part*)
**Brownlee, Oswald H.** Income Tax
**Brownlow, Rt. Rev. William R.,** D.D. Catacombs (*in part*)
**Bruce, Barry Wallace.** Boxmaking
**Bruce, William Cabell.** Randolph, John
**Brues, Charles Thomas.** Ant
**Brugel, Fritz.** Kautsky, Karl
**Bruman, Henry J.** Argentina (*in part*); Chile (*in part*); Peru (*in part*); South America (*in part*)
**Brummitt, Wyatt B.** Photography (*in part*)
**Brundage, Avery.** Olympic Games
**Bruno, Frank John.** Relief (*in part*)
**Brunson, Mark V.** Barracks (*in part*)
**Brunstetter, Max Russell,** Motion Pictures (*in part*)
**Brunt, David.** Dust; Rainbow
**Bryant, Carroll L.** Drowning and Lifesaving
**Bryce, Rt. Hon. James, 1st Viscount Bryce.** Justinian I (*in part*)
**Bryce, R. B.** Budget (*in part*)
**Bryson, Gladys.** Nation, Carry
**Bryson, John.** English Literature (*in part*)
**Buchanan, Sir George Seaton,** M.D. Public Health (*in part*)
**Buchanan, L. M.** Dongola (*in part*)
**Buchanan, Norman Sharpe.** Company Promotion
**Buchholz, John T.** Gymnosperms (*in part*)
**Buck, Solon Justus.** Minnesota (*in part*)
**Buckle, George Earle.** Balfour, Arthur James Balfour (*in part*); Grey of Fallodon, Edward Grey (*in part*); Law, Andrew Bonar; McKenna, Reginald
**Buckley, Francis.** Glass (*in part*)
**Buckley, Millard.** Rolls-Royce Limited (*in part*)
**Buckman, Harry Oliver.** Physical Natural Resources (*in part*)
**Buckmaster, Barbara.** Rumania (*in part*); Vladimirescu, Tudor
**Bucy, Paul C.,** M.D. Apoplexy; Brain (*in part*)
**Budberg, Baroness Maura.** Drama (*in part*)
**Budden, Lionel Bailey.** Architectural Education (*in part*)
**Buddenbrock-Hettersdorf, Wolfgang Von.** Sight, Sense of; Touch, Sense of
**Buddington, Arthur F.** Sill
**Buettner-Janusch, John.** Central America (*in part*)
**Bull, A. J.** Bank-Notes (*in part*)
**Bullene, Major General E ...** Warfare
**Bulliet, Clarence Joseph.** Chicago (*in part*)
**Bullock, Alan.** Germany (*in part*)
**Bullock, Fred.** Veterinary Science (*in part*)
**Bullocke, J. G.** Austrian Succession, War of The (*in part*); Collingwood, Cuthbert Collingwood (*in part*), Copenhagen (*in part*); First of June (*in part*), French Revolutionary Wars (*in part*), Lepanto, The Battle of (*in part*), Napoleonic Campaigns (*in part*), Nile, Battle of The (*in part*); Saints, Battle of The (*in part*); Toulon (*in part*); Trafalgar, The Battle of (*in part*)
**Bunbury, Sir Edward Herbert.** Pompeii (*in part*), Ptolemy (*in part*)
**Bunche, Ralph J.** Beira, Belgian Congo (*in part*), Nairobi; Portuguese East Africa or Mozambique (*in part*)
**Bunn, E. S.** Brass Manufactures (*in part*)
**Burford, Thomas Hannahan,** M D Heart and Lung, Surgery of
**Burg, Anton B.** Borax; Boric Acid; Borides, Boron
**Burges, William Charles.** Newcastle
**Burgess, Ernest Watson.** Park, Robert Ezra
**Burgess, Robert Wilbur.** Graphic Methods in Mathematics
**Burke, Agnes.** Children's Games (*in part*)
**Burke, Henry Penn.** Rowing (*in part*)
**Burkholder, Paul Rufus.** Botanical Society of America
**Burkitt, Francis Crawford,** D.D ... Bible (*in part*), Edessa (*in part*); ... Syriac Language
**Burkitt, Miles Crawford.** Archaeology (*in part*), Eoliths; Flints, Typology
**Burkman, Eric C.** United States Rubber Company
**Burls, G. A.** Internal Combustion Engines
**Burn, William Laurence.** British Honduras (*in part*), Guiana (*in part*)
**Burnet, Frank Macfarlane,** M D. Filterable Viruses
**Burnham, William H.** School Hygiene and Physical Education
**Burpee, Lawrence Johnston.** Ottawa (*in part*)
**Burrard, Major Sir Gerald.** Big Game Hunting, Pig-Sticking or Hog-Hunting (*in part*)
**Burrow, Thomas.** India (*in part*)
**Burrows, George Thomas.** Bowls (*in part*)
**Burrows, Millar, B.D.** Job
**Burrows, William.** Cholera
**Burrows, Rt. Rev. Winfrid Oldfield, D.D.** Absolution
**Burstein, Sona Rosa.** Tabu
**Burtt, Harold Ernest.** Psychology (*in part*)
**Bury, John Bagnell.** Alexius I; Alexius II (*in part*); Alexius III; Gibbon, Edward (*in part*); Roman Empire, Later
**Bury, John Patrick Tuer.** France (*in part*)
**Bush, Douglas.** English Literature (*in part*)
**Bush, Vannevar.** Harmonic Analysis
**Bushnell, Asa A.** Football (*in part*)
**Buss, Kenneth Caron.** Aleppo (*in part*); Cyprus (*in part*); Egypt (*in part*); Iraq (*in part*); Lebanon (*in part*); Persia (*in part*); Sudan; Sudan, ... (*in part*), Syria (*in part*); ... *t*)
**Butler, Arthur John.** Dante (or Durante) Alighieri (*in part*)
**Butler, Rt. Rev. Edward Cuthbert.** Benedict of Nursia, Saint; Brigittines; Canon (*in part*); Clara, Saint; Dominic, Saint (*in part*); Franciscans; Francis of Assisi, St. (*in part*); Groat, Gerhard (*in part*); Imitation of Christ, The (*in part*); Mabillon, John; Maurists; Mechithārists; Mendicant Movement and Orders (*in part*); Servites or "Servants of Mary"; Thomas of Celano; Trappists
**Butler, Eliza Marian.** Kafka, Franz
**Butler, Elmer Grimshaw.** American Society of Zoologists
**Butler, Francis H.** Compass (*in part*); Hunter, John (*in part*)

**Butler, H. J.** Carriage
**Butler, Nicholas Murray.** Columbia University
**Butler, Richard A.** Conservative Party, British
**Burr, A. B.** Mississippi (*in part*)
**Butts, Allison.** Copper (*in part*)
**Buxton, Claude E.** Transfer of Training
**Buxton, L. H. Dudley.** Ainu, Asia Minor (*in part*), Basra (*in part*), China (*in part*), Euphrates; Kirghis, Kish, Mesopotamia (*in part*); Mongolia (*in part*), Mosul (*in part*), Nineveh, Nippur, Races of Mankind, Sarts, Seleucia, Shurappak, Tigris; Turkomans; Turks (*in part*), Ur
**Buxton, Travers.** Slavery Convention
**Byerly, Perry.** Earthquakes
**Byers, Horace Robert.** Atmospheric Electricity; Blizzard; Brocken Bow, Spectre [illegible] Convection, Crepuscular Rays, Cyclone; Doldrums, Gale, Hurricane, Insolation, Isallobars, Isobar; Isopycnic, Isosteres, Storm
**Byrd, Harry Flood.** Virginia (*in part*)
**Byrd, Richard Evelyn.** Peary, Robert Edwin
**Byrne, Paul Ryan.** Notre Dame, University of (*in part*)

**Cabrera, Luis.** Carranza, Venustiano
**Cadbury, Henry Joel,** D D. Luke, Gospel of
**Caddow, H. A.** Burgundy Wines; Champagne Wines, Claret, Hock, Moselle Wines; Port Wine, Sauternes, Sherry
**Cadman, John, 1st Baron Cadman.** Anglo-Persian (now Anglo-Iranian) Oil Company, Ltd (*in part*)
**Cady, George H.** Krypton
**Cady, Gilbert Haven.** Coal and Coal Mining (*in part*), Lignite; Neon, Xenon
**Caesar, George V.** Starch (*in part*)
**Cahill, John.** Daylight Saving (*in part*)
**Cairns, James Ford.** Australia (*in part*), Bushrangers
**Cajori, Florian.** Binomial Formula, Geometry (*in part*), Logarithms
**Calderon, Jose M.** Olive Oil
**Caldwell, Thomas,** D D Scotland, Church of (*in part*)
**Caldwell, William Elmer.** Gold (*in part*)
**Calingaert, George.** Organometallic Compounds (*in part*)
**Calkins, Mary W.** Royce, Josiah (*in part*)
**Callan, Norman.** English Literature (*in part*)
**Callendar, Hugh Longbourne.** Black Body; Calibration; Heat (*in part*), Thermodynamics (*in part*), Vaporization
**Callender, Sir Geoffrey Arthur Romaine.** Armada, The (*in part*); Austrian Succession, War of The (*in part*), Chioggia (*in part*), Collingwood, Cuthbert Collingwood (*in part*); Copenhagen (*in part*), Dutch Wars (*in part*); Exile of Elba (*in part*), French Revolutionary Wars (*in part*), Grand Alliance, War of The (*in part*), La Hogue, Battle of (*in part*); Lepanto, The Battle of (*in part*); Napoleonic Campaigns (*in part*), Navarino, Battle of (*in part*), Nile, Battle of the (*in part*), Quiberon Campaign and Battle of (*in part*); Saints, Battle of the (*in part*), Seven Years' War (*in part*); Spanish Succession, War of The (*in part*), Toulon (*in part*); Trafalgar, The Battle of (*in part*)
**Callwell, Major General Sir Charles Edward.** Balkan Wars, 1912-13; Dardanelles Campaign, Mesopotamia, Operations in
**Calman, William Thomas.** Barnacle, Branchiopoda (*in part*), Cirripedia (*in part*), Copepoda (*in part*), Crab (*in part*), Crustacea (*in part*), Malacostraca (*in part*), Ostracoda; Rotifera (*in part*), Teredo (*in part*), Trilobita; Water-Flea, Wood Louse (*in part*)
**Calver, James L.** Everglades
**Cam, Helen M.** Borough (*in part*); Mayor (*in part*)
**Cameron, Norman Alexander,** M D. Abnormal Psychology, Defense Mechanisms; Hallucination
**Cammaerts, Emile.** Belgium (*in part*), Mercier, Désiré
**Campbell, Arthur Trevor.** New Zealand (*in part*), Seddon, Richard John
**Campbell, Rev. Lewis.** Jowett, Benjamin (*in part*)
**Campbell, Mildred.** Absentee Ownership
**Campbell, Walter Stanley.** Sitting Bull
**Campion, Sir Gilbert Francis Montriou.** Parliament (*in part*)
**Cana, Frank Richardson.** Africa (*in part*); Angola (*in part*), Belgian Congo (*in part*); Benin; Cameroons (*in part*), Congo; Congo Free State (*in part*), Egypt (*in part*); French Guinea (*in part*); Gold Coast (*in part*), Liberia (*in part*), Madagascar (*in part*), Natal (*in part*); Niger, Nigeria (*in part*), Nyasaland Protectorate (*in part*); Portuguese East Africa or Mozambique (*in part*), Rio de Oro, St Helena (*in part*); Senussi and Senussites (*in part*), Sierra Leone; Stanley, Sir Henry Morton, Sudan, Anglo-Egyptian (*in part*); Timbuktu (*in part*), Togo (*in part*), Togoland (*in part*), Transvaal (*in part*), Tripolitania (*in part*), Uganda (*in part*), Wadai (*in part*); Zambezi
**Canby, Henry Seidel.** Cather, Willa Sibert; Lewis, Sinclair (*in part*)
**Cannon, Clarence.** Parliamentary Law
**Capers, Gerald M.** New Orleans (*in part*)
**Capper, Arthur.** Kansas (*in part*)
**Carey, Clifford M.** Young Men's Christian Association
**Carlsen, Emil.** Still-Life Painting
**Carlson, Anton Julius,** M D Temperance (*in part*)
**Carlston, Kenneth S.** Blockade (*in part*); Neutrality (*in part*)
**Carlyle, Margaret Monteith.** Italy (*in part*); Sicily (*in part*)
**Carmichael, Colin.** Crank (*in part*); Horsepower
**Carmichael, Robert Daniel.** Barycentric Calculus; Diagram (*in part*), Dimension, Geometries, Finite; Infinity and the Infinite; Limit
**Carmody, John M.** Relief (*in part*)
**Carpender, J. W. J.,** M D. Radiology (*in part*)
**Carpenter, Charles M.,** M D. Leprosy (*in part*)
**Carpenter, F. M.** Neuroptera (*in part*)
**Carpenter, Rhys.** Spain (*in part*)
**Carpenter, Thorne Martin.** Animal Heat
**Carpenter, William M.** Electricity Supply: Technical Aspects (*in part*)
**Carr, Albert Raymond Maillard.** Bonde, Gustav
**Carr, Sir Cecil.** Provisional Order
**Carrel, Alexis,** M.D Tissue Culture
**Carrier, Willis H.** Air Conditioning (*in part*)
**Carroll, George.** Winter Sports
**Carroll, Henry King.** Mennonites (*in part*); Moravian Brethren (*in part*)
**Carroll, John Anthony.** Eclipse (*in part*)
**Carr-Saunders, Sir Alexander Morris.** Eugenics; Population
**Carson, George Barr, Jr.** Bolshevism (*in part*)
**Carter, Elliott C.** Music (*in part*)
**Carter, George Stuart.** Animals, Phylogeny of
**Carter, H. B.** Reuters (*in part*)
**Cartier, Jacques.** Jewellery (*in part*)
**Cartwright, Morse Adams.** Adult Education (*in part*)
**Carver, Thomas Gilbert.** Subsistence (*in part*)
**Cary, Max.** Aetolia [illegible] des; Athens (*in part*); [illegible] ene (*in part*); Justin II, Macedonian Empire; Manuel I, Comnenus, Pericles; Phrygia; Plataea; Punic Wars, Salamis
**Case, H. C. M.** Agricultural Economics (*in part*); Agricultural Labourer (*in part*); Farm Management (*in part*); Farm Rents (*in part*)
**Casey, Robert Pierce.** Anathema (*in part*); Simon Magus
**Casey, Robert S.** Ink (*in part*)
**Casey, T. W.** War Pensions (*in part*)
**Cassels, Donald E.,** M.D. St. Vitus' Dance
**Cassino, Jay Allen.** Government Departments (*in part*)
**Cassirer, Ernst.** Neo-Kantianism, Rationalism, Substance, Transcendentalism, Truth
**Casson, Stanley.** Rumania (*in part*)
**Castle, Egerton.** Book-Plates
**Cater, Harold Dean.** Minnesota (*in part*)
**Cathcart, Edward Provan,** M D. Nutrition
**Caton-Thompson, Gertrude.** Stratigraphy
**Cauthen, Charles Edward.** South Carolina (*in part*)
**Cavan, Ruth Shonle.** Suicide
**Ceadel, Eric Bertrand.** Japanese Literature
**Cecil, Lady Gwendolen** Salisbury, Robert Arthur Talbot Gascoyne-Cecil, 3rd Marquis of
**Černý, Jaroslav.** Horus
**Cestre, Charles.** Poe, Edgar Allan
**Chadwick, Sir David Thomas.** Imperial Economic Committee (*in part*)
**Chadwick, Hector Munro.** Anglo-Saxons, Britain (*in part*), Goths (*in part*), Jutes; Teutonic Peoples (*in part*); Thor
**Chadwick, James.** Radioactivity, Natural (*in part*)
**Chalmers, Henry.** Tariffs (*in part*)
**Chalmers, Sir Mackenzie Dalzell.** Bill of Exchange (*in part*); Sale of Goods (*in part*)
**Chamberlin, William Henry.** Brunei (*in part*), Fiji, Gilbert and Ellice Islands, Japan (*in part*), Melanesia, New Britain; New Hebrides, Pacific Islands (Oceania), Russia (*in part*), Tonga
**Chambers, Sir Edmund Kerchever.** Shakespeare, William (*in part*)
**Chambers, H.** Seed Trade (*in part*)
**Chambers, Robert.** Micromanipulation or Microsurgery (*in part*); Protoplasm (*in part*)
**Champion, Pierre.** Joan of Arc (*in part*)
**Chancellor, Edwin Beresford.** Clubs (*in part*)
**Chandrasekhar, Subrahmanyan.** Chromosphere (*in part*), Galaxy
**Chaney, Ralph Works** [illegible]
**Channing, Edward.** Adams, John; Adams, John Quincy; Adams, Samuel
**Chapman, Charles Edward.** California (*in part*); Cuba (*in part*)
**Chapman, Guy Basil Granville.** Kontagora (*in part*)
**Chapman, Sydney.** Atmosphere; Aurora Polaris
**Chapple, Bennett.** Tin-Plate and Terne-Plate
**Charles, Cecil Marvin,** M D Reproductive System (*in part*)
**Charles, Robert Henry,** D D Apocalyptic Literature (*in part*), Apocryphal Literature (*in part*), Baruch (*in part*); Daniel (*in part*), Enoch, Book of (*in part*), Ezra, Fourth Book (or Apocalypse) of (*in part*), Jeremy, Epistle of; Jubilees, Book of (*in part*), Judith, The Book of (*in part*); Minor Prophets, Book of (*in part*); Moses, Assumption of; Solomon, Psalms of; Testaments of The Twelve Patriarchs
**Charleston, Robert Jesse.** Wedgwood, Josiah
**Charr, Robert,** M D Respiratory System, Diseases of
**Charters, Alexander Crane, Jr.** Spark Photography (*in part*)
**Chase, Edna Woolman.** Forms of Address (*in part*)
**Chase, Philip Putnam.** New England
**Chase, Winn W.** Cotton and the Cotton Industry (*in part*); Rain-Proof Fabrics
**Chaumeix, André.** France, Anatole
**Cheatham, Elliott E.** Legal Education (*in part*)
**Chen, Pu-lai.** World War II (*in part*)
**Cheney, Sheldon.** Theatre (*in part*)
**Chesterton, Gilbert Keith.** Dickens, Charles John Huffam
**Cheyne, Rev. Thomas Kelly,** D.D. Esther (*in part*); Jonah
**Child, Charles Manning.** Axial Physiological Gradients
**Childe, V. Gordon.** Europe (*in part*); Scythia (*in part*); Skara Brae
**Childs, Marquis William.** Adams, Brooks
**Chinnock, A. Vaughan.** Phosgene
**Chipman, William Joseph.** Football (*in part*)
**Chisholm, Cecil.** Instalment Selling (*in part*)

**Chisholm, Hugh.** Albert, Prince Consort of England, Balfour, Arthur James Balfour, 1st Earl of (*in part*), Canton (*in part*), Edward VII (*in part*), George IV (*in part*), Meredith, George, Parliament (*in part*), Sherbrooke, Robert Lowe, Walter, John (*in part*)
**Chitwood, B. G.** Nematoda
**Chivers, Joseph Hardy, M D** Industrial Medicine (*in part*)
**Cholet, Bertram.** Brush (*in part*)
**Chopra, Ram Nath, M D.** Opium Eating and Opium Smoking
**Chree, Charles.** Inclinometer
**Christensen, Aksel E.** Denmark (*in part*)
**Christians, William F.** Siam (*in part*)
**Chrystal, George.** Perpetual Motion (*in part*)
**Church, George Earl.** Plata, Rio de la, or River Plate (*in part*)
**Church, Leslie Frederic.** Wesleyan Methodist Church
**Church, P. E.** United States (of America), The (*in part*)
**Church, Randolph W.** Virginia (*in part*)
**Church, The Very Rev. Richard William, D.D.** Lombards or Langobardi (*in part*)
**Cislak, Francis Edward.** Coal Tar, Creosote; Tars, Low-Temperature (*in part*); Toluene
**Clancy, Frederick M. ("Fog Horn").** Rodeo
**Claremont, Claude A.** Montessori System
**Clark, Albert Curtis.** Cicero
**Clark, Alfred Joseph, M.D.** Heart, Comparative Physiology of
**Clark, Austin Hobart.** Echinoderma (*in part*); Sea-Urchin (*in part*); Star-Fish
**Clark, Charles Edward.** Appeal (*in part*); Landlord and Tenant (*in part*); Practice and Procedure (*in part*)
**Clark, Charles Manning Hope.** Australian Literature
**Clark, Eugene Francis.** Dartmouth College
**Clark, George Lindenberg.** X-Rays, Nature of (*in part*)
**Clark, George Norman.** Holland (*in part*); Netherlands (*in part*)
**Clark, Harry Hayden.** Freneau, Philip Morin
**Clark, Walter.** Filters, Light; Photography (*in part*)
**Clark, William Bell.** Barry, John; Biddle, James; Conyngham, Gustavus; Dale, Richard; Du Pont, Samuel Francis; Fiske, Bradley Allen; Fleet Auxiliary Vessels; Fleet, Naval (*in part*); Gleaves, Albert; Hopkins, Esek; Jones, Jacob; Jones, John Paul, King, Ernest Joseph (*in part*); Leahy, William Daniel; Marines (*in part*); Mayo, Henry Thomas; Truxton, Thomas
**Clark, William D.** Crown; Customhouse (*in part*); Rupee (*in part*); Sterling
**Clark, Sir William Henry.** Trade Facilities
**Clark, W(illiam) Mansfield.** Hydrogen Ions
**Clarke, Alexander Ross.** Map (*in part*)
**Clarke, E. Gladys.** Cookery (*in part*); Salad; Sauce
**Clarke, George Sydenham, 1st Baron Sydenham of Combe.** Graeco-Turkish War
**Clarke, Rev. William Kemp Lowther, D.D.** Apollos; Catechumen; Joseph of Arimathaea; Matthias (Disciple); Philip (Evangelist)
**Clay, Charles.** Alberta (*in part*); British Columbia (*in part*); Canada (*in part*); Chatham (New Brunswick); Chatham (Ontario); Chicoutimi; Crémazie, Octave; Drummondville, Guelph; Kingston (Ontario); Labrador (*in part*); Manitoba (*in part*); New Brunswick (*in part*), Newfoundland (*in part*), Northwest Territories (*in part*); Nova Scotia (*in part*), Ontario (*in part*); Ottawa (*in part*); Parker, Sir Gilbert; Prince Edward Island (*in part*), Quebec (province) (*in part*); Rouyn; St. Pierre and Miquelon; Saskatchewan (*in part*); Saskatoon; Shawinigan Falls; Three Rivers; Timmins; Toronto (*in part*); Ungava; Vancouver; Victoria; Winnipeg, Yukon Territory
**Clay, Reginald S.** Kaleidoscope; Mirror (*in part*)
**Clemence, Gerald M** Time Measurement (*in part*)
**Clement, Martin W.** Pennsylvania Railroad Company, The
**Clements, F.** Bessemer Steel (*in part*), Blast Furnace (*in part*)
**Clerc, Charly.** Ramuz, Charles Ferdinand
**Clerke, Agnes Mary.** Astronomy (*in part*); Copernicus or Kopernik, Nicolaus; Galileo Galilei (*in part*); Herschel, Alexander (*in part*); Mayer, Johann Tobias (*in part*)
**Clery, Arthur** [illegible] Laws (*in part*)
**Clifford, Sir Hugh.** Borneo (*in part*); Borneo, North (*in part*), Johore (*in part*); Malacca; Malay Language (*in part*), Malays
**Clifton, Colonel Chester V.** Korean War (*in part*)
**Climenhaga, Rev. A. W.** Brethren in Christ
**Clinchy, Everett Ross.** Anti-Semitism (*in part*)
**Cline, Howard F.** Acapulco, Anahuac; California, Lower; Campeche (state), Campeche or Campeche de Baranda; Casas Grandes; Durango (state); Durango (Mexican city); Hidalgo; Manzanillo; Matamoros; Mazatlán; Mexico (*in part*); México; Mexico, Federal District of; Mexico City; Monterrey; Nayarit, Nuevo Leon, Oaxaca, Oaxaca de Juarez; Mérida; Michoacán, Orizaba; Puebla (city); Puebla; Quintana Roo; Queretaro, Salina Cruz; Saltillo; Sinaloa; Sonora, Tlaxcala; Toluca, Valladolid, Veracruz (state); Veracruz (town)
**Clouzot, E.** International Bureaus
**Clymer, Floyd.** Motorcycles (*in part*)
**Coad, B. R.** Boll Weevil, Cotton (*in part*)
**Cobb, George Watson, Jr.** Canning, Commercial (*in part*)
**Cobb, James Harrel.** Churches of Christ; Jehovah's Witnesses
**Cobb, John W.** Gas Manufacture (*in part*)
**Cochaux, Henri.** Arbitration (*in part*)
**Cockerell, Douglas B.** [illegible] (*in part*)
**Cockfield, Francis Ar[illegible]ax.** In Practice (*in part*)
**Cocks, Dorothy.** Hair (*in part*), Manicuring
**Coe, Wesley R.** Nemertea; Sex Ratio (*in part*)
**Coetzee, Abel Jacobus.** South African Literature (*in part*)
**Coffman, Lotus Delta.** Minnesota, University of (*in part*)
**Cogdon, Ronald Stephenson.** Jetty (*in part*)
**Coggeshall, Lowell T., M.D** Malaria
**Coghill, Robert de Wolf.** Purines
**Cohen, Arthur Le Roy.** Mycetozoa or Myxomycetes
**Cohen, E. Richard.** Fundamental Physical Constants (*in part*)
**Cohen, I. Bernard.** Camera Obscura
**Cohen, Julius Henry.** Port Authority (*in part*)
**Cohen, Karl.** Diffusion
**Coker, Ernest George.** Pulley
**Cole, Alan Summerly.** Textile Printing (*in part*)
**Cole, Felix.** Algeria (*in part*); Algiers (*in part*)
**Cole, George Douglas Howard.** Butler, Samuel; Carey; Cobbett, William; Co-operation; Fabian Society, Guild Socialism; Industrial Councils; Industrial Court; Industrial Health Board; Marx, Karl Heinrich (*in part*); Labour Party, The; Minimum Wage (*in part*); Socialism; Strikes and Lockouts (*in part*); Syndicalism; Trade (Labour) Unions (*in part*)
**Cole, LaMont C.** Physical Natural Resources (*in part*)
**Cole, Leon Jacob.** Sex Ratio (*in part*)
**Cole, Sanford D.** Affreightment; Bottomry; Code; Fisheries, Law of (*in part*)
**Cole, Sonia Mary.** Baringo; Kenya (colony) (*in part*)
**Cole, Sydney W.** Proteins
**Coleman, Arthur Philemon.** Canada (*in part*); Quebec (*in part*)
**Coleman, Christopher Bush.** Indiana (*in part*)
**Coleman, G. S.** Sanitation of Buildings (*in part*); Sewer Construction
**Coleridge, Ernest Hartley.** Byron, George Gordon Byron, 6th Baron (*in part*)
**Colles, Henry Cope.** Ravel, Maurice
**Collier, Theodore Freylinghuysen.** Innocent (*in part*), Sixtus V
**Collin, W. E.** Canadian Literature (French)
**Collinge, Walter E.** Ornithology (*in part*)
**Collins, George Rowland.** Jobber; Retailing (*in part*)
**Collins, Henry B.** Cahokia Mound (*in part*); Miami, Pueblo (*in part*)
**Collins, K. Ruth.** Drop Forging (*in part*)
**Collins, Rt. Rev. William Edward, D.D.** Establishment (*in part*), Testamentum Domini
**Collum, V. C. C.** Carnac (*in part*), Stone Monuments, Primitive
**Collyer, Brigadier General John J.** East Africa, Operations in
**Colvin, Charles Herbert.** Air Log or Air Distance Recorder
**Colvin, Fred Herbert.** Automatic Machines, Machine-Tools (*in part*); Valves (Mechanical)
**Colvin, Sir Sidney.** Bellini (*in part*); Durer, Albrecht (*in part*); Giorgione (*in part*); Giotto (*in part*), Leonardo da Vinci (*in part*), Michelangelo (*in part*)
**Colyer, Douglas** Air Forces (*in part*); Air Raids; Government Departments (*in part*); Great Britain (*in part*)
**Comber, Christine.** Bruce of Melbourne, Stanley Melbourne Bruce, 1st Viscount
**Compton, Arthur Holly.** Compton Effect; Washington University
**Comrie, Leslie John.** Ephemeris
**Condit, Ira Judson.** Fig; Olive
**Condliffe, John B.** Free Trade; Most-Favoured-Nation Treatment
**Connell, Sir Charles Gibson.** Landlord and Tenant (*in part*)
**Connick, Robert Elwell.** Cadmium (*in part*); Francium, Zinc (*in part*)
**Conolly, Harold.** School Architecture (*in part*)
**Contenau, G., M D.** Asia Minor (*in part*)
**Converse, Paul D.** Broker
**Conway, Robert Seymour.** Iovilae; Praeneste (*in part*)
**Conybeare, Frederick Cornwallis.** Ablution; Armenian Literature (*in part*)
**Coode, Arthur T.** Dredges and Dredging (*in part*)
**Cook, A. C.** Cattle (*in part*)
**Cook, James Wilfred.** Carcinogenic Hydrocarbons; Hydrocarbon; Naphthalene
**Cook, Sherman Lawrence.** Boston (*in part*)
**Cook, Stanley Arthur, D.D.** Baal (*in part*); Chronicles, Books of (*in part*); Damascus (*in part*); Decalogue (*in part*); Edom (*in part*); Genealogy (*in part*), Genesis; Gideon (*in part*); Haggai (*in part*); Hezekiah (*in part*); Jacob (*in part*); Jesus Christ (*in part*); Jews (*in part*); Joshua, Book of; Judges, The Book of (*in part*); Kings, First and Second Books of; Levites (*in part*); Moab; Moloch (*in part*); Moses (*in part*); Nabataeans (*in part*); Philistines; Ruth, Book of; Sabbath (*in part*); Samuel, Books of; Serpent Cults; Sinai; Talmud (*in part*); Zephaniah
**Cook, Thomas Ira.** Authority, Political; Republic
**Cooke, Rev. George Albert, D.D.** Ezekiel; Odaenathus (*in part*); Palmyra; Phoenicia; Zenobia (*in part*)
**Coolidge, Rev. William Augustus Brevoort.** Arnaud, Henri; Dauphiné (*in part*); Jenatsch, Georg; Lugano, Lake of; Switzerland (*in part*); Tell, William (*in part*); Zürich (capital) (*in part*)
**Coomaraswamy, Ananda K.** Bronze and Brass Ornamental Work (*in part*); Dance (*in part*); Indian and Sinhalese Art and Archaeology; Indian Architecture (*in part*); Indonesian and Further Indian Art; Iron in Art (*in part*); Textiles and Embroideries (*in part*); Yaksas
**Coomber, Denis Irvine.** Wine (*in part*)
**Cooper, B. K.** Ibadan

**Cooper, Delmer Clair.** Angiosperms (*in part*)
**Cooper, G. Arthur.** Brachiopoda
**Cooper, John I.** Breadner, Lloyd Samuel; Canada (*in part*); Newfoundland (*in part*)
**Cooper, Kent.** Associated Press (*in part*)
**Cooper, Robert William.** Berlin (*in part*)
**Copping, George.** Chinaware (*in part*); Earthenware
**Corbett, Harvey Wiley.** Architecture
**Corbett, Percy E.** Laws of War
**Corddry, Graham W.** Colour Mill
**Cordonnier, Louis Emilien Victor.** Frontier, Battles of the (*in part*)
**Cornell, Constance Margaret.** Chamberlain, Arthur Neville, George VI (*in part*)
**Corner, George Washington.** Embryology, Human (*in part*)
**Corrigan, Cecil Edwin, M.D** Tumour
**Corthorn, Charles E. L.** Ottoman Bank (*in part*)
**Corwin, Alsoph Henry.** Pyrrole
**Cottington-Taylor, Mrs. Dorothy Daisy.** Carving (*in part*); Menus; Preserving and Bottling (*in part*)
**Cotton, James Sutherland.** Hastings, Warren (*in part*); Omichund
**Cottrell, Frederick Gardner.** Fume Precipitation, Electrical
**Coulson, Major Thomas.** Research, Industrial (*in part*)
**Coulter, John Wesley.** Capiz
**Coulton, George Gordon.** Concubinage; Knighthood and Chivalry (*in part*); Reformation
**Countryman, Vern.** Bankruptcy (*in part*)
**Coursey, Philip R.** Condenser (Electrical)
**Courtney, Giles L.** Account; Account Current; Account Rendered; Account Sales; Accounts Payable Ledger; Accounts Receivable (*in part*); Accounts Receivable Ledger; Current Assets
**Courtney, Janet Elizabeth.** Alexandra, Queen
**Cowie, Alexander.** Novel (*in part*)
**Cowl, Richard Pope.** Edda (*in part*); Icelandic Literature (*in part*)
**Cowles, Walter Goodman.** Engineering Insurance (*in part*)
**Cowley, Sir Arthur Ernest.** Samaritans; Seadiah, Ben Joseph
**Cox, Alonzo Bettis.** Cotton and the Cotton Industry (*in part*); Cotton Belt
**Cox, H. E.** Food Preservation (*in part*); Jams and Jellies (*in part*)
**Cox, Isaac Joslin.** Chile (*in part*); Wilkinson, James
**Cox, Major General Sir Percy Zachariah.** Fars (*in part*); Firuzabad; Hormuz; Kerman; Khurasan, Khuzistan (*in part*); Kuchan; Kurdistan (*in part*); Laristan, Lingeh; Persia (*in part*); Persian Gulf, Qain (*in part*); Qais; Resht; Seistan (*in part*); Shiraz; Tabriz (*in part*); Tehran Province (*in part*); Yezd (*in part*)
**Cox, Warren Earle.** Batik; Cartoon (*in part*); Design (*in part*); Drawing (*in part*); Gothic Art; Lamp (*in part*); Periods of Art (*in part*); Sculpture Technique (*in part*)
**Cox, William B.** Chain Gang
**Coxeter, Harold Scott Macdonald.** Mathematical Models (*in part*); Surface (*in part*)
**Crackanthorpe, Montague Hughes.** Mediation (*in part*)
**Craddock, Sir Reginald Henry.** Bilaspur (*in part*); Central Provinces and Berar (*in part*); Chhattisgarh (*in part*); Chhindwara (*in part*)
**Craies, William Feilden.** Habeas Corpus (*in part*); Quarter Sessions, Court of (*in part*); Trade Marks (*in part*); Treason (*in part*); Warrant (*in part*); Wildlife Conservation and Management (*in part*); Witness (*in part*)
**Craigmyle of Craigmyle, Thomas Shaw, 1st Baron.** Vergniaud, Pierre Victurnien (*in part*)
**Cranage, Very Rev. David Herbert Somerset, B.D.** University Extension (*in part*)
**Crandall, Lee S.** Aviary and Aviculture (*in part*)
**Crane, Charles Howard.** Theatre (*in part*)
**Crane, J. B.** Steam Generation (*in part*)
**Crane, Walter.** Arts and Crafts Movement, The (*in part*)
**Cranstone, Bryan A. L.** Dayaks; Kayan; Kenyah, Klemantan, Negritos, Nicobar Islands (*in part*)
**Craven, Avery O.** Washburne, Elihu Benjamin
**Cravens, Kenton R.** Reconstruction Finance Corporation (*in part*)
**Crawford, John Grenfell.** Australia (*in part*)
**Crawford, Nelson Antrim.** Nonpartisan League
**Crawford, Osbert Guy Stanhope.** Archaeology (*in part*); Barrow, Mound-Builders
**Creager, William Pitcher.** Dams (*in part*)
**Creed, Rev. John Martin, B.D.** Baptism (*in part*); Bible (*in part*); Eucharist (*in part*)
**Cret, Paul Philippe.** Library Architecture (*in part*); Renaissance Architecture (*in part*)
**Crew, F. A. E., M.D.** Albino; Fertility and Fecundity (*in part*), Genetics; Hermaphrodite (*in part*), Mendelism, Selection (*in part*); Sex (*in part*)
**Crew, Henry.** Langley, Samuel Pierpont; Millikan, Robert Andrews (*in part*); Physical Units (*in part*); Rutherford, Ernest; Thomson, Sir Joseph John
**Criegee, Rudolf.** Ozonides
**Crile, George W., M.D.** American College of Surgeons
**Cripps, Rev. Richard Seymour.** Amen
**Croce, Benedetto.** Aesthetics
**Crocker, William.** Boyce Thompson Institute for Plant Research, Inc. (*in part*)
**Crockett, Walter Hill.** Vermont (*in part*)
**Crombie, Alistair Cameron.** Swammerdam, Jan; Spallanzani, Lazaro
**Crommelin, Andrew C. de la C.** Comets (*in part*); Eros; Minor Planet (*in part*)
**Crookshank, Arthur Kennedy.** Territorial Army
**Cross, Charles Frederick.** Fibres
**Cross, Harold L.** Press Laws (*in part*)
**Croswell, V. R.** Naval Stores
**Crouzet, François Marie-Joseph.** Agenais or Agenois; Bar, Counts and Dukes of; Blois, Countship of; Limousin; Lorraine; Louis X; Nogaret, Guillaume de; Orleanais; Orleans, Louis, Duke of; Poitou; Roussillon
**Crowdy, Dame Rachel.** Opium Traffic (*in part*)
**Crowe, Sir Edward Thomas Frederick.** Consul (*in part*)
**Crowe, G. E. W.** Household Appliances (*in part*)
**Crowe, Brigadier General John Henry Verinder.** Plevna, Shipka Pass
**Crowe, Sir Joseph Archer.** Calais (*in part*); Eyck, Van (*in part*), Holbein, Hans
**Crowe, Sibyl Eyre.** Algeria (*in part*), Morocco (*in part*); Tangier (*in part*); Tunisia (*in part*)
**Crowfoot, John Winter.** Palestine (*in part*)
**Crowne, Irving H.** Magneto, High-Tension
**Crue, Francis De.** Geneva (*in part*)
**Cruikshank, Robert, M.D.** Antiseptics (*in part*)
**Crump, Norman E.** Bank of England; Commercial Paper (*in part*); Consols; International Payments (*in part*); Kran; Mint Par of Exchange (*in part*); Pools, in Industry (*in part*); Rial; Rupee (*in part*); Shares; Transfer (*in part*)
**Cubberley, Ellwood Patterson.** Education, History of (*in part*)
**Culbertson, Ely.** Auction Bridge (*in part*); Bridge (*in part*), Contract Bridge (*in part*); Whist (*in part*)
**Culin, Stewart.** Dolls; Headdress; Masks
**Culley, A. B.** Agents in Business
**Cullinan, Frank P.** Apricot; Cherry; Nectarine; Peach; Plum; Quince
**Cummins, Colonel Stevenson Lyle, M.D.** Tuberculosis (*in part*)
**Cunningham, James V.** Anthology
**Cunynghame, Sir H. Hardinge.** Clocks (*in part*)
**Curran, C. H.** Anopheles; Bee Fly; Black Fly; Bloodworm; Bluebottle; Botfly; Deer Fly; Diptera; Drosophila, Flesh Fly; Fly; Frit Fly; Fruit Fly; Fungus Gnat; Gallfly; Gall Midge; Hessian Fly; Horsefly, Horsefly, Hover Fly; Leatherjacket; Louse (*in part*); Onion Maggot; Robber Fly; Tachinid Fly; Screwworm
**Curtis, Edmund.** Ireland (*in part*); Robert Guiscard (*in part*); Roger I; Roger II (*in part*)
**Curtis, George M., M.D.** Thyroid
**Curtis, Harry Alfred.** Fertilizers, Liming, Nitrogen, Fixation of; Phosphorus
**Curtis, Harvey L.** Current Balance
**Curtis, William Edward.** Band Spectrum
**Curtiss, David Raymond.** Bessel Function
**Cushendon, 1st Baron of (Ronald John McNeill).** Bunker Hill; Grattan, Henry, Jeffreys, George Jeffreys, 1st Baron
**Cussons, G. W.** Mathematical Models (*in part*)
**Cutter, Donald C.** California (*in part*); San Diego

**Dack, Gail M., M.D.** Food Poisoning, Bacteriological
**Daggett, Harriet S.** Birth, Legal Aspects of
**Daggett, Stuart.** Inland Water Transport (*in part*)
**Dakin, William John.** Onychophora (*in part*)
**Dakyns, Arthur L.** Co-Partnership
**Dalby, W. Ernest.** Dynamometer; Power Transmission (*in part*)
**Dale, E. E.** Branding (*in part*)
**Dale, Ernest.** Keynes, John Maynard
**Dale, Harold Edward.** Agricultural Education (*in part*)
**Dalgas, Frederick.** Pottery and Porcelain (*in part*)
**Dalton, H. E.** Studebaker Corporation, The
**Dalton, Nellis Norman.** Glycerin (Glycerol)
**Dalton, Ormonde M.** Catacombs (*in part*)
**Dalton, W. Bézique.** Piquet, Vingt-Et-Un
**Daly, Reginald Aldworth.** Igneous
**Dameshek, William, M.D** Anaemia; Blood (*in part*); Haemophilia
**D'Amico, Silvio.** Pirandello, Luigi
**Dampier, Sir William Cecil.** Electrolysis (*in part*); Science
**Danielli, (Mrs.) Mary.** Hova
**Daniels, A. M.** Chimney (*in part*)
**Daniels, Harry J.** Burial (*in part*)
**Dannatt, C. W.** Assaying
**Danzig, Allison.** Rackets or Racquets (*in part*); Squash Rackets (*in part*)
**Darby, Henry Clifford.** Fens
**Darling, Frank Fraser.** Scotland (*in part*)
**Darlington, William Aubrey.** Drama (*in part*)
**Darrow, George McMillan.** Bilberry, Blaeberry or Whortleberry; Blackberry; Blueberry; Currant; Dewberry or Trailing Blackberry; Gooseberry; Raspberry; Strawberry
**Darrow, Karl Kelchner.** Physics
**Darton, F. J. Harvey.** Children's Books (*in part*)
**Darwin, Sir Charles Galton.** Light (*in part*)
**Das, H.** Dutt, Toru; Ghose, Lalmohun
**Davenport, Major Cyril James H.** Mezzotint or Mezzo Tinto
**Davey, William Nelson.** Marine Insurance (*in part*)
**Davids, Caroline A. F. Rhys.** Pali Language and Literature (*in part*)
**Davids, T. W. Rhys.** Devadatta; Mahāvaṃsa (*in part*); Pali Language and Literature (*in part*)
**Davidson, Rev. Samuel, D.D.** Canon (*in part*)
**Davies, Alan Fraser.** Australia (*in part*)
**Davies, Audrey M.** Municipality (*in part*)
**Davies, Cuthbert Collin.** Akbar, Jalal ud-din Mohammed, Asoka; Aurangzeb, Mohi ud-din Mohammed; Baber, Zahir ud-din Mohammed; Bengal (*in part*); Central Provinces and Berar; Ceylon (*in part*); Child, Sir John; Cholas; Dewan; India (*in part*); India, French; Kashmir (*in part*); Kaw; Kunbi; Mogul; Punjab (*in part*)
**Davies, Rev. James.** Hesiod (*in part*)
**Davies, Colonel Percy George.** Croquet (*in part*)

**Davies, Ralfe D.** Bridging, Military (*in part*)
**Davies, Randall (Robert Henry).** Caricature (*in part*)
**Davies, Reginald Trevor.** Bedmar, Alfonso de la Cueva; Spain (*in part*)
**Davis, Arthur Llewellyn.** Negligence
**Davis, Fanny-Fern.** Greens
**Davis, Hallowell, M D.** Deaf-mutism, Medical Aspects of
**Davis, Harold Thayer.** Mathematical Tables
**Davis, Henry William Carless.** Ambrose; Benedictus Abbas; Bohun, Charles, The Great; Geoffrey of Monmouth (*in part*); Gerard (Archbishop); Gilbert Foliot, Henry I, Henry II; Henry III; John (King of England), Lanfranc (*in part*); Langton, Stephen; Mandeville, Geoffrey De [illegible] Montfort, Simon De (*in part*); Nennius; Odo of Bayeux; Orderic Vitalis (*in part*); Richard I, Richard (Earl of Cornwall); Stephen (1097?–1154); Theobald; Wace, Robert (?); Walter of Coventry, William I; William of Newburgh
**Davis, John M.** Delaware, Lackawanna and Western Railroad Company, The
**Davis, J. S.** Rural [illegible] (*in part*)
**Davis, Kenneth S.** Eisenhower, Dwight D.
**Davis, Malvin E.** Industrial Insurance (*in part*)
**Davis, Mary Dabney.** Kindergarten (*in part*)
**Davis, Ozora Stearns, D.D.** Congregationalism (*in part*)
**Davis, Sir Robert H.** Divers and Diving Apparatus
**Davis, S. C. H.** Motor Racing (*in part*)
**Davis, William.** Lace (*in part*)
**Davis, William Morris.** America (*in part*); Coral Reefs; North America (*in part*)
**Davison, Eloise.** Housekeeping (*in part*); Washing Machines
**Davison, John A.** Gutta Percha (*in part*)
**Dawson, Christopher William.** Borneo (*in part*); Borneo, North (*in part*); Sarawak
**Dawson, George Walter.** Flower Painting
**Dawson, Harry Medforth.** Chemical Action
**Dawson, James P.** Boxing (*in part*); Sullivan, John Lawrence (*in part*)
**Dawson, Mitchell.** Divorce (*in part*); Infant; Libel and Slander (*in part*)
**Dawson, Warren Royal.** Imhotep: Mummy
**Daysh, George Henry John.** Free Ports (*in part*)
**Dean, Carlton Miles.** Sulphuric Acid (*in part*)
**Dean, John Gilbert.** Nickel
**Dean, Leon W.** Vermont (*in part*)
**Dean, Ruth.** Landscape Architecture (*in part*)
**Dean, Winton Basil.** Bizet, Georges
**Debenham, Frank.** Antarctic Regions (*in part*)
**De Bray, Reginald George Arthur.** Serbo-Croatian Language (*in part*)
**D'Eca, Raul.** Aracajú, Aracatí; Araguaia; Bagé; Brazil (*in part*), Ceará (*in part*); Espírito Santo (*in part*); Fernando Noronha (*in part*); Pará (*in part*); Paraná (state) (*in part*); Pelotas; Pernambuco (*in part*); Piauí (*in part*), Rio de Janeiro (city) (*in part*); Salvador, São Paulo (state); São Paulo (city)
**De Castro, Morris F.** St. Thomas
**Decker, Maurice H.** Camping (*in part*)
**Dederick, Louis Serle.** Ballistics
**Deese, Sara L.** Trade: World Statistics (*in part*)
**Defenbach, Byron.** Idaho (*in part*)
**DeGolyer, Everette Lee.** Salt Domes
**Deighton, Herbert Stanley.** Abbas II; Fuad I; Egypt (*in part*); Gordon, Charles George; Mohammed, Ahmed ibn Seyyid 'Abdullah; Shagia; Sudan, Anglo-Egyptian (*in part*)
**Deignan, Herbert Girton.** Asia (*in part*)
**Delahaye, Colonel James Viner.** Woolwich (*in part*)
**Delanglez, Rev. Jean, S.J.** Marquette, Jacques
**Delehaye, Rev. Hippolyte, S.J.** Canonization; Helena, St.; Roch, St.; Vitus, St.
**Deller, Sir Edwin.** London University (*in part*)
**Delmelle, Joseph-Edouard-Marie-Ghislain.** Belgian Literature (*in part*)
**Delme-Radcliffe, Lieutenant Colonel Emilius C.** Falconry (*in part*)
**De Mille, Cecil Blount.** Motion Pictures (*in part*)
**Dempster, Arthur J.** Mass Spectroscopy (*in part*)
**Dendy, Fred L.** Acting (*in part*), Inlaying
**Dengel, Philipp Ignaz.** Papacy (*in part*)
**Denham, William Smith.** Silk and Sericulture (*in part*); Silk Manufacture (*in part*)
**Denney, Charles Eugene.** Northern Pacific Railway
**Dennis, Charles H.** Field, Eugene
**Denno, Bryce F.** Battalion; Supply and Transport, Military
**Denno, Wilfred L.** Electrocution
**Denny, Edward M. C.** Bill of Exchange (*in part*)
**Dent, Harold Collett.** Central Schools; Commercial Education (*in part*), Education, History of (*in part*); Elementary Education (*in part*), Polytechnic (*in part*); Secondary Education (*in part*), Teachers, Training of (*in part*); Technical Education (*in part*); Universities (*in part*)
**Denton, George Bi[illegible], Teeth, Artificial**
**Derrick, Calvin.** Reformatory School (*in part*)
**Derrick, (John) Michael.** Italy (*in part*)
**Dervan, Sidney L.** Militia, National Guard
**Desart, Ellen Odette, Countess Dowager of Desart.** Forms of Address (*in part*)
**Deschamps, Hubert [illegible]** Guiana (*in part*); Senegal [illegible] French; Tunis (*in part*)
**Desjardins, Arthur Ulderic, M.D.** Finsen, Niels Ryberg
**Despois, Jean-Jacques.** Algeria (*in part*); Morocco (*in part*), Tunisia (*in part*)
**DeTurk, Ernest E.** Sail (*in part*)
**Deutsch, Herman Julius.** Washington
**Deutscher, Isaac Stalin, Joseph Vissarionovich**
**Dewey, Hewson S.** Submarine
**Diamond, Louis Klein, M D.** Blood Transfusion
**Dibble, Barry.** Electric Power: National and Regional Schemes (*in part*)
**Dicken, Samuel N.** Culiacán or Culiacán Rosales; Monterrey; Quintana Roo
**Dickins, Arthur W. M.** Gallic Acid
**Dickinson, Hobart Cutler.** Calorimetry
**Dicksee, Lawrence Robert.** Accountancy and Accountants (*in part*); Bookkeeping, Cost Accounting (*in part*); Goodwill; Liquidation (*in part*); Overhead Charges; Stock-Taking
**Dickson, Henry Newton.** Mexico, Gulf of
**Diehl, Harold S(heely), M D.** Cold, Common
**Dikaios, Porphyrios.** Cyprus (*in part*)
**Dike, K. Onwuka.** Sokoto (*in part*)
**Dilke, Lady.** Millet, Jean François (*in part*)
**Dilliard, Irving.** Bok, Edward William
**Dillman, Arthur C.** Flax (*in part*)
**Dillon, Emile J.** Alphonso XIII (*in part*)
**Dillon, Mary Earhart.** Willard, Frances Elizabeth Caroline (*in part*)
**Dingle, Herbert.** Sun (*in part*)
**Dinsmoor, William Bell.** Greek Architecture
**Dinsmore, Wayne.** Horsemanship and Riding (*in part*)
**Disney, A. W. M.** Fazughli; Fung; Sennar
**Dixon, George Campbell.** Hughes, William Morris (*in part*)
**Dixon, Harold Baily.** Chemistry (*in part*)
**Dixon, Roland Burrage.** Calchaquian
**Dobson, Austin.** Hogarth, William (*in part*); Kauffmann (Maria Anna) Angelica; Richardson, Samuel (*in part*)
**Dobzhansky, Theodosius.** Hybridism
**Dock, George, Jr.** Falconry (*in part*)
**Dodd, Edwin Merrick.** Company and Corporation Law (*in part*)
**Dodd, Walter Fairleigh.** Amendment: American Law (*in part*). Constitution and Constitutional Law (*in part*); United States (of America), The (*in part*)
**Dodgson, Campbell.** Dry Point (*in part*)
**Dods, Marcus, D.D.** Pelagius (*in part*)
**Doll, Edgar Arnold.** Mental Deficiency
**Dollman, Captain J. G.** Deer (*in part*); Game Reserves (*in part*); Insectivora (*in part*)
**Donahey, Victor.** Ohio (*in part*)
**Donald, Sir Robert.** Newspapers (*in part*)
**Donald, William John.** Employees, Training of
**Donaldson, B. R.** Ford Motor Company
**Dondore, Dorothy Anne.** Biography (*in part*)
**Donnay, Joseph Désiré Hubert.** Crystallography (*in part*), Goniometer (*in part*)
**Donnelly, Philip J., S.J.** Grace
**Donovan, Major General William Joseph.** Intelligence Military, Supreme Court of the [illegible]es, The
**Doran, Walter Edmund.** Drainage of Land (*in part*)
**Dorfman, Albert, M.D.** Rheumatic Fever
**Dorizzi, F. P.** Pencil
**Doster, James F.** Alabama
**Doucet, Roger.** France (*in part*), Mornay, Philippe de
**[illegible] Arthur G.** Frontenac et Palluau, [illegible] Buade, Meighen, Arthur (*in part*)
**Douglas, George William.** Flag (or "Flagge") (*in part*), Franklin Institute, The, Pennsylvania (*in part*)
**Douglas, Mary M.** Yao
**Douglas, Sir Robert Kennaway.** Hsuan Tsang [illegible] Jenghiz Khan, Mongols (*in part*); [illegible], Sir Harry Smith; Tsêng Kuo-Fan
**Dow, Edward French.** Maine (*in part*)
**Dow, George.** London and North Eastern Railway Company, The
**Dowie, H. G.** Kent's Cavern
**Dowley, Francis H.** Highmore, Joseph
**Downey, William G., Jr.** Espionage
**Dowson, Robert.** Turbine: Steam
**Dragstedt, Carl Albert, M D.** Anaphylaxis
**Dragstedt, Lester R., M D.** [illegible] denal Ulcer; Peritonitis
**Drew, Edward L.** Hides (*in part*)
**Drew, Frederic William.** Chartreuse (*in part*)
**Drew, Philip.** English Literature (*in part*)
**Driberg, Jack Herbert.** Africa (*in part*); Age-Grades; Angoni; Ankole, Ganda; Hehe; Lango; Masai, Nyika; Secret Societies (*in part*)
**Driver, Godfrey Rolles.** Assyrian Language, Bible (*in part*); Hebrew Language; Jehovah; Semitic Languages
**Driver, Samuel Rolles, Hon. D.D.** Bible: Old Testament (*in part*)
**Drover, Engineer Captain F. J.** Marine Engineering; Rotor Ship
**Drower, Margaret Stefana.** Egypt (*in part*)
**Drum, Hugh Aloysius.** St. Mihiel (*in part*)
**Drummond, Rev. William Hamilton, D.D.** Reunion, Church
**Drury, F. E.** Building (*in part*); Foundations (*in part*), Structural Engineering (*in part*)
**Drysdale, Charles V.** Instruments, Electrical
**Duchesne, Louis Marie Olivier.** Calixtus or Callistus (*in part*); Gelasius (*in part*); Liberius (*in part*); Lucius (*in part*); Papacy (*in part*); Sixtus
**Duck, Frank J. G.** Lithopone; Mercurochrome
**Duckworth, Wynfrid Laurence Henry, M.D.** Anthropometry
**Dudeney, Henry Ernest.** Magic Square
**Dudley, A. M.** Motor, Electric (*in part*)
**Duecker, Werner Wilfred.** Sulphur
**Duff, James H.** Pennsylvania (*in part*)
**Duff, Rt. Hon. Sir Mountstuart Elphinstone Grant.** Oliphant, Laurence (*in part*)
**Duffy, Francis P.** Gibbons, James (Cardinal)
**Duflou, Guillaume.** Flemish Language, The
**Dumas, Paul.** Motor Racing (*in part*)
**DuMond, Jesse William Monroe.** Fundamental Physical Constants (*in part*); X-Rays, Nature of (*in part*)
**Dunbabin, Thomas James.** Sicily (*in part*)
**Duncan, Delbert J.** Department Store
**Duncan, F. Martin.** Hair (*in part*)
**Dunhill, Alfred.** Pipe Smoking
**Dunkerley, G. D.** Educational Associations (*in part*)
**Dunn, Charles James.** Drama (*in part*)
**Dunn, L. C. Bateson;** William; Monster

**Dunnage, James A.** Importing In Practice (*in part*)
**Dunsheath, Percy.** Engineering Education (*in part*)
**Dunstan, Albert E.** Kerosene (*in part*), Paraffin
**Du Pont, Lamemot.** Du Pont de Nemours and Company, E I
**Durant, William James.** Dewey, John; Santayana, George (*in part*)
**Duranty, Walter.** Russia (*in part*)
**Durkee, M. M.** Soybean Oil
**Durst, Alan L.** Sculpture Technique (*in part*)
**Du Shane, Graham Phillips.** Degeneration
**Dushman, Saul.** Thermionics
**Du Toit, Alexander L.** Gondwanaland (*in part*)
**Dutt, Romesh Chunder.** Vidyasagar, Iswar Chandra
**Dyboski, Roman.** Mickiewicz, Adam (*in part*); Poland (*in part*); Polish Literature, Poznan or Posen (*in part*)
**Dymond, J. R.** Canada (*in part*)
**Dyson, Sir Frank Watson.** Parallax

**Earnest, John P.** Arson (*in part*), Inebriety, Law of (*in part*)
**Earnshaw, Frank L.** Game Reserves (*in part*)
**Eastwood, George Anderson.** Armour and Company
**Eaton, Sir F. A.** Academy, Royal (*in part*)
**Eaton, Joseph Wechsler.** Farm Colony or Group Farm
**Eaton, Russell Brayton.** Zirconium
**Ebenstein, William.** Fascism, Economics of
**Ebert, Robert H.,** M.D Bronchitis, Pleurisy or Pleuritis; Pneumothorax
**Eccles, William Henry.** Wireless Telegraphy (*in part*)
**Eckart, Carl.** Ether (in Physics)
**Eckberg, Adrian.** Gilding (*in part*)
**Eckenstein, Kenneth Edward.** Monaco (*in part*)
**Eckert, Wallace John.** Calculating Machines (*in part*)
**Eckhardt, Karl August.** Germanic Laws, Early (*in part*); Salic Law (*in part*)
**Eckman, Jeannette.** Delaware (*in part*)
**Eddington, Sir Arthur Stanley.** Aberration of Light; Algol; Astronomy (*in part*); Centaurus, Cetus; Constellation (*in part*); Micrometer (*in part*); Sirius; Star (*in part*); Telescope (*in part*); Time, Standard
**Eddy, Helen L.** Crop-Drying; Cultivation; Reaping; Sowing
**Edgell, Vice-Admiral Sir John Augustine.** Chart; Sounding
**Edlén, Bengt.** Corona
**Edmonds, Brigadier General Sir James Edward.** Loos. The Battle of Marne, The First Battle of the, Ypres The Battle of, 1914; Ypres, The Battles of, 1915
**Edmunds, Arnold.** Estate Duties; Legacy Duty and Succession Duty
**Edmundson, Rev. George.** Brabant; Flanders (*in part*); Gelderland (*in part*); Jacoba or Jacqueline; Oldenbarneveldt, Johan Van (*in part*); Orange, House of; Pensionary
**Edwards, Alba M.** Domestic Service (*in part*)
**Edwards, Arthur Cecil.** Turkey (*in part*)
**Edwards, Everett E.** Agricultural Organization (*in part*); Agricultural Research; Agricultural Societies and Shows (*in part*); Agriculture, A General Survey (*in part*); American Farm Bureau Federation; Arable; Creameries; Crops, Farmers' Clubs; Farmers' Organizations; Farmers' Union; Grange, The; International Conferences of Agricultural Economists; Thrashing or Threshing
**Edwards, Harry Taylor.** Abacá Fibre; Sisal Fibre
**Edwards, Kathleen.** Cathedral (*in part*)
**Edwards, Morris O.** Court-Martial (*in part*)
**Edwards, Ralph.** Interior Decoration (*in part*)
**Edwards, Major T. J.** Captain (*in part*), Colours, Military (*in part*); Honourable Artillery Company; Lance; Numismatics (*in part*); Quartermaster (*in part*); War Office (*in part*)
**Egbert, James Chidester.** University Extension (*in part*)
**Eggeling, H. Julius.** Hinduism (*in part*), Sanskrit Language and Literature (*in part*)
**Egginton, Leslie Ernest.** Motoring (*in part*)
**Eichelberger, William Snyder.** Newcomb, Simon
**Einstein, Albert.** Space-Time (*in part*)
**Einzig, Paul.** Bank for International Settlements (*in part*), Capital Levy (*in part*)
**Eisele, C. Wesley,** M.D. Malta Fever or Mediterranean Fever
**Eisenhart, Luther Pfahler.** Affine Geometry; Riemannian Geometry
**Eisenmann, Louis.** Bohemia (*in part*)
**Ekblaw, Walter Elmer.** Chichen-Itzá or Chichen, Colossal Cavern; Dismal Swamp; Dunes; Mammoth Cave; Uxmal, Wyandotte Cave, Yellowstone National Park
**Elbe, Guenther von.** Combustion
**Elias, Maxim K.** Pliocene
**Ehel, Leon Theodore.** Photogrammetry
**Eliot, Sir Charles Norton Edgcumbe.** Asia (*in part*); Huns (*in part*); Japan (*in part*); Khiva (*in part*)
**Eliot, Charles William.** Gray, Asa
**Eliot, Martha May,** M.D. Maternal and Child Health (*in part*)
**Eliot, Thomas Dawes.** Civil Liberties
**Elkin, Adolphus Peter.** Australia (*in part*)
**Ellard, Gerald, S. J.** Mass (*in part*)
**Elles, G. L.** Palaeozoic Era
**Ellingham, H. J. T.** Electrochemistry
**Elliott, George Blow.** Atlantic Coast Line Railroad Company
**Elliott, Ivo D'Oyly.** Biron; Lefebvre, Pierre François Joseph
**Elliott, Norman Robson.** Free Ports (*in part*)
**Elliott-Binns, Rev. Leonard Elliott,** D.D. Balaam (*in part*); Jashar, Book of; Numbers (*in part*)
**Ellis, B. Eldred.** Glove Manufacture
**Ellis, Sir (Robert) Geoffrey.** Peerage
**Ellsworth, Paul Theodore.** International Payments (*in part*)
**Elmslie, Rev. William Alexander Leslie,** Hon. D.D. Prophet
**Ely, Burl A.** International News Service
**Ely, Richard R.** Luzon
**Embree, Edwin Rogers.** Negro, The American (*in part*); Philanthropy (*in part*)
**Emerson, Alfred E.** Species (*in part*); Wheeler, William Morton
**Emerson, Haven,** M.D. Public Health (*in part*)
**Emery, Walter Bryan.** Egypt (*in part*)
**Emison, John C.** American Smelting and Refining Company, The
**Emmons, Gardner.** Cloud (*in part*)
**Enfield, Ralph R.** Agricultural Credit (*in part*)
**Engel, Edward J.** Atchison, Topeka and Santa Fe Railway Company
**Engerrand, George C.** Mexico (*in part*)
**Engle, Nathanael Howard.** United States (of America), The (*in part*)
**English, Earl Franklin.** Journalism, Schools of (*in part*)
**Ennis, George Pearse.** Water-Colour Painting
**Enslin, Morton Scott.** Galatians, Epistle to the
**Epps, Sir George Selby Washington.** Superannuation (*in part*)
**Epstean, Edward.** Photo-Engraving
**Epstein, Isidore.** High Place; Judaism
**Erdman, Frederick Seward.** Food Preservation (*in part*)
**Erickson, Milton Hyland,** M.D Hypnotism
**Ernst, Fritz.** Swiss Literature (*in part*)
**Esau, Katherine.** Plants and Plant Science (*in part*)
**Esdaile, Arundell.** Libraries (*in part*)
**Esher, 2nd Viscount, Reginald Baliol Brett.** Edward VII (*in part*)
**Esmein, Jean Paul H. E. A.** Appanage; Bailiff and Bailie (*in part*); Basoche; Châtelet; Code Napoléon (*in part*); French Law and Institutions (*in part*); Lettres de Cachet; Parlement, Provost, Taille (*in part*)
**Essex, Hiram Eli.** Shock and Collapse
**Essig, E. O.** Entomology (*in part*)
**Estelow, Richard Kempton.** Methane
**Estes, Joseph Alvie.** Horse Racing and Breeding (*in part*)
**Esval, Orland E.** Earth Inductor Compass
**Eusterman, George B.,** M D Alimentary System, Diseases of the
**Evans, D. M. H.** Nubia (*in part*)
**Evans, E. E.** Denmark (*in part*)
**Evans, Herbert Walter Lloyd.** Mint (*in part*)
**Evans, Joan.** Jewellery (*in part*)
**Evans, John W.** Devonian System, The
**Evans, Oren Frank.** Waves and Shore Currents and Their Work
**Evans, Owen David.** Schools, Evening (*in part*)
**Evans, Richard Edgar.** Spark Photography (*in part*)
**Evans, Richard L.** Latter-Day Saints, Church of Jesus Christ of (*in part*)
**Evans, Ulick Richardson.** Corrosion and Oxidation of Metals
**Everard, W. J.** Barges and Canal Craft
**Everitt, Charles.** Constellation (*in part*)
**Everstine, Carl N.** Maryland (*in part*)
**Ewen, David.** Ackté, Aíno; Alfano, Franco
**Ewing, Sir (James) Alfred.** Air-Engine, Siemens, Sir William; Steam; Steam Engine
**Ewing, H. E.** Apterygota; Arthropoda, Springtail
**Eyre, John D.** Japan (*in part*)

**Fage, John Donnelly.** Ashanti, Kumasi; Gold Coast (*in part*); West Africa (*in part*)
**Fagg, William Buller.** Belgian Congo (*in part*); Bobo; Dogon; Edo; Ewe; Mandingo; Muruts
**Fahrenfort, Jacob.** Stock Exchange (*in part*)
**Fahrnkopf, Harrison.** Granaries and Grain Elevators (*in part*)
**Fairbairn, John Shields,** M.D. Menopause
**Fairbank, Herbert Sinclair.** Roads and Streets (*in part*)
**Fairbanks, Helen R.** Dockyards and Naval Bases (*in part*)
**Fairchild, Charles Owen.** Thermometry
**Fairchild, Henry Pratt.** Americanization
**Fairchild, Iler J.** Standardization
**Fairweather, William,** D.D. Maccabees; Maccabees, Books of
**Falkner, Roland Post.** Machinery and Production
**Fallow, Thomas Macall.** Coronation; Crown and Coronet
**Falls, Laurence E.** Insurance: Miscellaneous
**Fanning, Leonard M.** Gasoline; Gasoline Pressure Appliances; Petroleum
**Farbman, Michael.** Russia (*in part*)
**Faris, John Thomson,** D.D. Arlington National Cemetery
**Farkas, Adalbert.** Hydrogen
**Farley, Joseph F.** United States Coast Guard Academy
**Farley, Mary L.** Goat (*in part*)
**Farmer, R. C.** Filtration
**Farnell, Lewis Richard.** Greek Religion (*in part*); Mystery (*in part*)
**Farnum, Royal Bailey.** Paul, Bruno
**Farquhar, Francis Peloubet.** Sequoia (*in part*); Sierra Nevada, The; Yosemite
**Farquharson, Alexander.** Branford, Victor
**Farrell, Edward Paul.** Apologetics
**Farrell, James A.** Gary, Elbert Henry
**Farren, William Scott.** Fuselage
**Faubel, Arthur L.** Cork
**Faunce, William H. P.,** D.D. Brown University
**Faust, Clarence Henry.** Puritanism
**Faust, Ernest Carroll.** Blackwater Fever; Kala-Ayar; Parasitic Diseases; Psorospermiasis; Sand-Fly Fever; Schistosomiasis; Sleeping Sickness; Yaws
**Faust, George Tobias.** Becker, George Ferdinand; Erythrite
**Fawkes, Rev. Alfred.** Establishment (*in part*)
**Faÿ, Bernard.** Franklin, Benjamin

**Fay, Sidney Bradshaw.** Berlin (*in part*); Hamburg (*in part*)
**Fayle, Charles Ernest,** Shipping, History of (*in part*)
**Feavearyear, Albert Edgar.** Pound Sterling (*in part*)
**Fell, Sir Arthur.** Channel Tunnel
**Fell, Robert Andrew.** Watches (*in part*)
**Fellows, George Emory.** Utah (*in part*)
**Felt, Ephraim Porter.** Galls
**Fennell, John Lister Illingworth.** Basil
**Fenneman, Nevin M.** United States (of America), The (*in part*)
**Fenton, Carroll Lane.** Bertrand, Marcel Alexandre (*in part*); Clarke, John Mason (*in part*); Lapworth, Charles (*in part*); Sorby, Henry C. (*in part*); Zittel, Karl Alfred (*in part*)
**Fenton, Mildred Adams.** Bertrand, Marcel Alexandre (*in part*), Clarke, John Mason (*in part*); Lapworth, Charles (*in part*); Sorby, Henry C. (*in part*); Zittel, Karl Alfred (*in part*)
**Ferber, Robert.** Market Index
**Ference, Michael, Jr.** Assmann, Richard; Cloud (*in part*); Fohn
**Ferguson, C. L.** Parliamentary Procedure
**Ferguson, Ralph Holmes.** Soap
**Ferguson, William Scott.** Greek Law
**Ferrier, J. Walter.** Heine, Heinrich (*in part*)
**Ferriss, Hugh.** Rendering, Architectural
**Fetrow, Ward Willard.** Agricultural Co-Operation (*in part*)
**Fetter, Frank Albert.** Clark, John Bates
**Fetter, Frank Whitson.** Commercial Treaties (*in part*)
**Few, William P.** Duke University (*in part*)
**Ffoulkes, Charles John.** Arms and Armour
**Ffoulkes, Constance Jocelyn.** Morelli, Giovanni (*in part*)
**Fidler, A. T.** Dunlop Rubber Company, Ltd.
**Field, Guy Cromwell.** Pacifism
**Fielding, Thomas James.** Selenium Cells
**Filbert, William J.** United States Steel Corporation
**Filer, Herbert.** Options
**Filman, Jack.** Ice Hockey (*in part*)
**Filon, Pierre Marie Auguste.** Drama (*in part*)
**Findlay, John Ritchie.** De Quincey, Thomas
**Finer, Herman.** Electoral Systems, Local Government; Proportional Representation (*in part*)
**Fink, Colin Garfield.** Bronze and Brass Ornamental Work (*in part*); Sculpture Technique (*in part*)
**Finkelstein, Herman.** Copyright (*in part*)
**Firth, John B.** Burnham, Edward Levy Lawson
**Firth, Raymond William.** Currency, Primitive; Economics, Primitive; Labour, Primitive; Magic (*in part*); Maori; Property, Primitive; Social Anthropology; Trade, Primitive; Wealth, Primitive
**Fischer, C. E. C.** India (*in part*)
**Fischer, Earl K.** Paints, Chemistry of
**Fischer, Eugen.** Holstein, Friedrich von
**Fischer, Martin Henry,** M.D. Dropsy
**Fish, Carl Russell.** Wisconsin (*in part*)
**Fishbein, Morris,** M.D. American Medical Association (*in part*); Health Visitor (*in part*); Medical and Surgical Societies (*in part*); Public Health (*in part*); Quackery (*in part*)
**Fishenden, Margaret White.** Smoke and Smoke Prevention (*in part*)
**Fisher, A.** Enamel (*in part*)
**Fisher, Allan George Bernard.** Imperial Preference; International Monetary Fund
**Fisher, Arthur.** Copyright (*in part*)
**Fisher, George J. B.** Chemical Warfare (*in part*)
**Fisher, Jacob.** County Home
**Fisher, Joel E.** Mountaineering
**Fisher, Ronald Aylmer.** Biometry
**Fisher, Russell Todd.** Sailcloth and Sailmaking (*in part*)
**Fisher, William Bayne.** Palestine (*in part*); Tripolitania (*in part*)
**Fiske, John.** Grant, Ulysses Simpson (*in part*); Parkman, Francis
**Fitch, James Burgess.** Dairy Machinery and Equipment
**Fitch, Rachel Louise.** Coeducation; Sororities (*in part*)
**Fitzmaurice, Edmund George, 1st Baron Fitzmaurice.** Commons (*in part*)
**Fitzmaurice-Kelly, James.** Barahona de Soto, Luis; Caballero, Fernán, Calderón de la Barca, Pedro; Campoamor y Campoosorio, Ramon de; Cervantes Saavedra, Miguel de; Lull (or Lully), Raimon (or Raymond); Nuñez de Arce, Gaspar, Palacio Valdés, Armando; Pereda, José María de, Picaresque Novel, The (*in part*); Quevedo y Villegas, Francisco Gómez de, Ruiz, Juan; Valera y Alcalá Galiano, Juan; Vega Carpio, Lope Felix de (*in part*)
**Fitzpatrick, Harry Morton.** Mushroom
**Flanagan, Urban Gerard.** Ireland (*in part*)
**Fleming, Sir Alexander.** Penicillin
**Fleming, Sir John Ambrose.** Electrical (or Electrostatic) Machine (*in part*)
**Fleming, Philip B.** Shipping, History of (*in part*), Shipping: Merchant Ships of the World
**Fleming, Richard Howell.** Atlantic Ocean (*in part*), Indian Ocean (*in part*), Ocean and Oceanography (*in part*), Pacific Ocean (*in part*)
**Fleming, R. M.** Bessarabia (*in part*); Far Eastern Area (*in part*); Kamchatka; Latvia (*in part*); Ossetian Autonomous Areas; Russia (*in part*); Siberian Area; Tajik Republic; Tatar Republic (*in part*); Ukraine (*in part*)
**Fleming, Walter Lynwood.** Lynching (*in part*); Nullification; Secession
**Flère, William A.** Inland Water Transport (*in part*)
**Fletcher, Fred.** Angling (*in part*)
**Fletcher, Harvey.** Noise and Its Control (*in part*)
**Flett, Sir John Smith.** Andesite (*in part*); Breccia; Concretion; Diorite; Gabbro (*in part*); Glauconite; Greisen; Laccolith; Lamprophyres; Marble (*in part*); Micropegmatite; Neck; Nepheline-Syenite or Elaeolite-Syenite (*in part*); Nephelinites; Obsidian; Peridotite; Perlite or Pearlstone; Phyllite; Pitchstone; Pneumatolysis, Porphyry; Pumice, Quartzite; Quartz-[illegible]; Scapolite (*in part*), Schorlomite, Soda-, Trachyte
**Fleure, Herbert John.** Asia (*in part*); Europe (*in part*); Gibraltar (*in part*); Tibet or Thibet (*in part*); Toulon (*in part*); Transylvania (*in part*)
**Flexner, Louis B.,** M.D. Meninges and Cerebrospinal Fluid
**Flink, Carl.** Radiator (*in part*)
**Flint, Einar P.** Firebrick
**Flint, Richard Foster.** Glacial Epoch (*in part*)
**Floe, Carl F.** Nitrogen Hardening
**Florey, Sir Howard Walter.** Lymph, Its Formation and Movement
**Flournoy, Richard W.** Nationality
**Flux, Sir Alfred William.** Production, Census of (*in part*); Statistics
**Foch, Ferdinand.** Army (*in part*)
**Foehringer, Anna.** Golitsyn, Boris Borisovich
**Foerster, Lieutenant Colonel Wolfgang.** Ludendorff, Erich (*in part*)
**Foley, James J.** Mass Production (*in part*)
**Foley, Raymond Michael.** Housing (*in part*)
**Foligno, Cesare.** Italian Language, Modern; Italian Literature (*in part*)
**Folks, Homer.** Poor Law (*in part*)
**Foote, Franklin Manley,** M.D. Blindness (*in part*)
**Foote, Peter Godfrey.** Icelandic Language
**Forbes, Alexander,** M.D. All-or-None Law
**Forbes, William T. M.** Ailanthus, Cynthia or Eria Silk Moth; European Corn Borer (*in part*); Lepidoptera (*in part*)
**Ford, Henry.** Mass Production (*in part*)
**Ford, Lester R.** Nomography
**Ford, Walter Armitage.** Song (*in part*); Wolf, Hugo
**Forsdyke, Sir Edgar John.** Africa (*in part*); Bronze and Brass Ornamental Work (*in part*); Crete (*in part*); Pottery and Porcelain (*in part*), Silversmiths' and Goldsmiths' Work (*in part*)
**Forsythe, W. E.** Electric Lamps, Manufacture of (*in part*)
**Forsythe, William R.** Nitric Acid and Nitrates (*in part*)
**Forter, Norman L.** Bessarabia (*in part*); Dobruja (*in part*)
**Fortescue, Hon. Sir John.** Peninsular War
**Fortescue-Brickdale, Sir Charles,** Land Titles (*in part*)
**Forward, Alexander.** Gas Manufacture (*in part*)
**Fosdick, Raymond Blaine.** New York (City) (*in part*); Rockefeller Benefactions (*in part*)
**Foss, Robert.** Wisconsin, University of
**Foster, John B.** Billiards (*in part*)
**Foster, John Watson.** Harrison, Benjamin
**Foster, Leon V.** Microscope (*in part*)
**Fotheringham, J. K.** Eclipse (*in part*)
**Fowler, W. Warde.** Fortuna; Mars
**Fox, Aileen.** Caerleon
**Fox, Lieutenant Colonel Charles James.** Salvage Corps (*in part*)
**Fox, Charles J. J.** Paper Manufacture (*in part*); Paper Materials
**Fox, Sir Cyril Sankey.** Bauxite (*in part*); Laterite
**Fox, Denis L.** Colours of Animals (*in part*)
**Fox, Howard,** M.D. Lupus
**Fox, Irving.** Flea
**Fox, John Jacob.** Salt (*in part*)
**Fox, Lione' W.** Prison (*in part*)
**Fox, Thomas W.** Spinning; Weaving (*in part*)
**Fox, William T. R.** Security
**Fox-Strangways, A. H.** Indian Music
**Frame, James E.** Colossians, Epistle to the
**Francis, A. G.** Salt (*in part*)
**Francis, Howard T.** Electroplating
**Francis, Thomas, Jr.,** M.D. Influenza
**Franck, James.** Hahn, Otto
**Frank, George Christian.** Erie Railroad
**Frank, Helena.** Yiddish Language and Literature (*in part*)
**Frank, Lawrence K.** Psychiatry (*in part*)
**Frank, Tenney.** Italy (*in part*); Rome (*in part*)
**Franklin, Ernest Louis.** Arbitrage (*in part*)
**Franklin, Henry James.** Cranberry
**Franklin, Sidney.** Bullfight
**Franklyn, Charles Aubrey Hamilton,** M.D. Robes (*in part*)
**Frantz, Henri.** Manet, Édouard; Puvis De Chavannes, Pierre Cécile (*in part*)
**Frantz, Joe B.** West, The (*in part*)
**Frary, Francis Cowles.** Aluminum or Aluminium
**Fraser, George Sutherland.** English Literature (*in part*)
**Fraser, Sir Ian.** St. Dunstan's
**Fraser, James Earle.** Sculpture (*in part*)
**Fraser, Peter Marshall.** Palestine (*in part*)
**Frazer, Sir James George.** Praeneste (*in part*)
**Frear, Walter Francis.** Hawaii (*in part*); Honolulu (*in part*)
**Frederick, Justus George.** Income Tax: In Practice (*in part*); Luxury Taxes (*in part*)
**Frederick, William L.** Apportionment Bill
**Free, Edward Elway.** Noise and Its Control (*in part*)
**Freeman, Douglas Southall.** Davis, Jefferson
**Freeman, Edward Augustus.** Goths (*in part*); Normans (*in part*); Syracuse (*in part*)
**Freeman, Frank Nugent.** Visual Education
**Freeman, John Derek.** Iban (Sea Dayaks)
**Freer, Robert Elliott.** Price Maintenance
**Freese, John H.** Calpurnius, Titus (*in part*); Hesiod (*in part*); Julian (*in part*); Leo VI
**French, Edward Sanborn.** Boston and Maine Railroad, The (*in part*)
**French, Myrtle Meritt.** Pottery and Porcelain (*in part*)
**French, Norman.** Hardware (*in part*)
**French, Thomas E.** Drawing, Engineering
**Frere, Rt. Rev. Walter Howard, D.D.** Plainsong, or Plain Chant

**Freud, Sigmund,** M.D. Psychoanalysis (*in part*)
**Friedman, William Frederick.** Codes and Ciphers
**Friedrich, Carl Joachim.** Government; Oligarchy; Representation
**Friesen, Otto von.** Runes
**Fritsch, Felix Eugen.** Photosynthesis (*in part*)
**Frondel, Clifford.** Argentite, Bertrandite, Cerussite; Chalcocite; Chalcopyrite or Copper-Pyrites (*in part*); Columbite, Emery, Humite; Sphalerite; Staurolite (*in part*); Strontianite (*in part*), Tetrahedrite (*in part*)
**Frost, Wesley.** Arequipa (city); Arequipa (department) (*in part*); Asunción; Bocas del Toro; Carapegua; Colón (*in part*); Concepción, Cuzco (*in part*); Iquitos; Junín; Libertad or La Libertad; Panamá (country) (*in part*), Panamá (city) (*in part*); Paraguay, Paraguay (*in part*); Pasco; Peru (*in part*), Piura, South America (*in part*); Villa del Pilar; Villarrica
**Fry, Roger.** Cézanne, Paul
**Fuchs, H.** Disconto-Gesellschaft, Berlin
**Fulford, Roger Thomas Baldwin.** Elizabeth II; Elizabeth
**Fuller, Edward.** Baby-Farming (*in part*); Foundling Hospitals
**Fuller, Major General John Frederick Charles.** Aornos, Siege of, Arras, Battle of (*in part*); Conscription (*in part*); Cavalry (*in part*); Constantinople, Siege of, Diadochi, Wars of; Dreux (*in part*); Formigny, Battle of (1450); Gaugamela (Arbela), Battle of; Granicus, Battle of The; Hydaspes Battle of The; Herda, Campaign of, Issus, Battle of; Ivry, Battle of (1590); Jemappes; Macedonian Army, Military Organization; Battle of (1071) (*in part*); Mantinea, Battle of; Mursa, Battle of; Neuve Chapelle, Battle of; Patay, Battle of (1429); Pavia (*in part*), Pharsalus, Battle of; Pydna, Battle of; Religious Wars of (1562–1609); Rocroi, Battle of; Taginae, Battle of (A.D. 552); Teutoburger Wald, Battle of; Thapsus, Battle of, Tyre (*in part*)
**Fuller, Walter Deane.** Curtis Publishing Company, The
**Fuller-Maitland, John Alexander.** Brahms, Johannes
**Fullmer, Irvin H.** Precision Gauges and Comparators
**Fulton, Jack.** Golf
**Furber, Holden.** Cape Province (*in part*); Durban (*in part*); Natal (*in part*)
**Furst, Clyde.** Philanthropy (*in part*)
**Fyfe, David Theodore.** Egyptian Architecture; Western Asiatic Architecture

**Gabriel, Ralph Henry.** Long Island (*in part*)
**Gabrielson, Ira Noel.** Fish and Wildlife Service; Wildlife Conservation and Management (*in part*); Wildlife Reserves
**Gadd, Cyril John.** Babylonian Law; Sumerian Language; Syria (*in part*)
**Gaffron, Hans.** Photosynthesis
**Gager, Charles Stuart.** Botanic Garden
**Gahan, Frank.** Damages; Wildlife Conservation and Management (*in part*)
**Gairdner, James.** Mary I; Talbot (Family) (*in part*)
**Gale, Esson M.** Asia (*in part*)
**Gall, Ralf.** Early Closing Movement (*in part*)
**Gallaher, Ruth Augusta.** Iowa (*in part*)
**Gallotti, Jean.** Wood-Carving (*in part*)
**Galloway, George,** D.D. Religion (*in part*)
**Galloway, George Barnes.** House of Representatives; Senate (*in part*); Speaker (*in part*)
**Galtsoff, Paul S.** Oyster; Sponges
**Gamble, W.** Music Printing
**Ganjei, Nasser D.** Land Taxes (*in part*)
**Ganoe, William Addleman.** Buena Vista (*in part*); Cerro Gordo; Chapultepec; Churubusco; Contreras; Palo Alto; Resaca de la Palma
**Gapen, C. E.** Agricultural Power and Machinery (*in part*)
**Garber, Daniel.** Landscape Painting (*in part*)
**Garcke, E.** Tramway (*in part*)
**Gardiner, Alfred G.** Oxford and Asquith, Herbert Henry Asquith, 1st Earl of
**Gardiner, Linda.** Birds, Protection of (*in part*)
**Gardiner, Samuel Rawson.** George I (*in part*); George II; George IV (*in part*)
**Gardner, Dorothy Ellen Marion.** Nursery Schools (*in part*)
**Gardner, E. G.** Dante (or Durante) Alighieri (*in part*)
**Gardner, Ernest Arthur.** Clazomenae, Inscriptions; Parthenon (*in part*); Propylaea
**Gardner, Percy.** Demetrius; Greek Art; Lysippus
**Gardner-Smith, Rev. P.,** B.D. Peter, St. (*in part*); Peter, First Epistle of; Peter, Second Epistle of
**Garland, John H.** Corn (Maize) Belt; Great Lakes, The
**Garner, James Bert.** Natural Gas
**Garnett, Richard.** Irving, Washington; Muller, Max (*in part*); Panizzi, Sir Anthony (*in part*); Peacock, Thomas Love (*in part*); Sarpi, Paolo; Satire (*in part*); Swift, Jonathan (*in part*)
**Garnett, W.** Energy (*in part*)
**Garrett, Henry Edward.** Differential Psychology
**Garrod, Heathcote William.** Wordsworth, William
**Garside, Alston H.** Cotton and the Cotton Industry (*in part*)
**Garstang, Walter.** Amphioxus or Lancelet; Pisciculture (*in part*)
**Garten, Hugo F.** Drama (*in part*)
**Garvie, A. E.,** D.D. Devil, Doctrine of; Immortality; Inspiration; Miracle; Predestination
**Gaselee, Sir Stephen.** Foreign Office (*in part*); Latin Literature (*in part*)
**Gaskin, John George Noel.** Rum
**Gaster, Moses.** Bassarab, or Bassaraba; Hasdeu or Hajdeu, Bogdan Pelriceicu; Sturdza; Vacarescu
**Gates, Marshall.** Morphine (*in part*)
**Gathorne-Hardy, Geoffrey Malcolm.** Norway (*in part*)
**Gatley, Clement.** Guarantee (*in part*); Libel and Slander (*in part*)
**Gaus, John Merriman.** Public Administration
**Gauvreau, Emile Henry.** Mitchell, William
**Gay, Edwin Francis.** Hanseatic League
**Gaynor, Lieutenant Colonel James K.** Military Law
**Gazin, Charles Lewis.** Tertiary
**Geddes, Norman Bel.** Theatre (*in part*)
**Geddes, William Robert.** Borneo (*in part*)
**Gedye, Nicholas George.** Beacon (*in part*); Breakwater; Caisson; Canals and Canalized Rivers (*in part*); Coast Protection and Land Reclamation (*in part*); Embankment; Fog Signals; Graving Dock; Groyne; Harbours (*in part*); Inland Water Transport (*in part*); Jetty (*in part*): Lighthouses (*in part*); Lock; Pier (*in part*); River and River Engineering (*in part*): Slipway; Weir; Zuider Zee (*in part*)
**Geikie, Sir Archibald.** Hutton, James (*in part*); Vesuvius (*in part*)
**Geldner, Karl Friedrich.** Zend-Avesta (*in part*)
**Gelston, Arthur S., Jr.** Brazil (*in part*)
**George, William R.** George Junior Republic, The
**Géraud, André.** Delcassé, Theophile
**Gerhardt, Paul L.** Port Operation (*in part*)
**Germundsson, Thor.** Concrete (*in part*)
**Gersh, Isidore.** Glands
**Geyer, Robert P.** Vitamins (*in part*)
**Geyl, Pieter.** Holland (*in part*); Holland, County and Province of (*in part*); William (the Silent)
**Ghormley, Ralph Kalb,** M.D. Orthopaedic Surgery
**Giachardi, Iva Lilian.** Austria (*in part*); Germany (*in part*)
**Gibb, Andrew Dewar.** Scots Law
**Gibb, Sir Hamilton Alexander R.** Abbasids; Abu Bekr; Almohades (*in part*); Almoravides (*in part*), Alp Arslan, Mohammed ibn Da'ud; Arabic Literature (*in part*); Caliphate; Omar, Persia (*in part*), Seljuks, Spain (*in part*); Syria (*in part*), Timur
**Gibb, Thomas R. P., Jr.** Hydrides
**Gibbons, Cedric.** Motion Pictures (*in part*)
**Gibson, Arnold Hartley.** Hydraulic Machinery; Hydraulic Power Transmission; Hydraulics; Pump; Tidal Power, Turbine Water
**Gibson, William M.** Howells, William Dean
**Gide, Charles.** Economic Man
**Gieseking, John Eldon.** Soil (*in part*)
**Giffen, Sir Robert.** Bagehot, Walter
**Gifford, Walter Sherman.** American Telephone and Telegraph Company, Telephone (*in part*)
**Gilbert, Alfred C.** Pole Vaulting
**Gilbert, Joseph.** Motor Car (*in part*)
**Gilbert, Milton.** United States (of America), The (*in part*)
**Gilbertson, George Waters.** Balochi Language
**Gilchrist, Raleigh.** Ruthenium
**Giles, Albert William.** Novaculite
**Giles, George W.** Allotments (*in part*)
**Giles, Peter.** Indo-Europeans
**Gill, Sir David.** Telescope (*in part*)
**Gill, Eric.** Stone Carving
**Gill, Richard Cochran.** Curare
**Gillam, Cornelius W.** Business Codes
**Gillies, Alexander.** German Literature; Novel (*in part*)
**Gillin, John P.** Piaroan; Warrau
**Gillmor, Reginald E.** Gyroscope (*in part*)
**Gilmore, Eugene Allen.** Iowa, State University of (*in part*)
**Gimbutas, Marija.** Balts, The (*in part*)
**Ginsberg, Morris.** Social Philosophy
**Ginsburg, Jekuthiel.** Euler Numbers or Eulerian Numbers, Stirling Numbers
**Girard, Jean.** Stone Dyes
**Girden, Edward.** Conditioning
**Gittinger, Roy.** Oklahoma
**Givens, Willard E.** Educational Associations (*in part*)
**Gladstone, Reginald John,** M.D. Brain (*in part*)
**Glaeser, Martin Gustave.** Public Utilities
**Glaister, John,** M.D. Poison (*in part*)
**Glanzman, George S.,** S.J. Apostle
**Glasgow, George.** Beneš, Eduard (*in part*); Locarno, Pact of; Masaryk, Thomas Garrigue
**Glazebrook, Sir Richard Tetley.** Newton, Sir Isaac (*in part*); Research, Industrial (*in part*)
**Gleichen, Major General Lord Edward Gleichen.** Abyssinia (*in part*)
**Glicksman, Maurice.** Neutron (*in part*)
**Gloor, Walter Ervin.** Celluloid
**Glover, Arnold.** Layard, Sir Austen Henry (*in part*)
**Gloyd, Howard K.** Chicago Academy of Sciences, The (*in part*)
**Gluckman, Max.** Barotse, Barotseland
**Goddard, Colonel Calvin.** Ammunition; Armoured Car; Artillery (*in part*); Balloons in War; Canteen; Cantonment; Engines of War; Gun, Machine: Gunpowder (*in part*); Ordnance (*in part*); Pistol; Small Arms, The Development of
**Godfrey, Hugh.** Dial and Dialling (*in part*)
**Goeje, Michael Jan de.** Arabic Literature (*in part*)
**Goering, Paul L.** Conscientious Objector
**Goes, Clifford.** Rowing (*in part*)
**Goethals, George Washington.** Panama Canal (*in part*)
**Goetz, Hermann.** Mohammedan Architecture; Mohammedan Art
**Goitein, Hugh.** Jurisprudence; Jurisprudence, Comparative (*in part*); Sale of Goods (*in part*)
**Goldenweiser, E. A.** Central Bank
**Goldie, Sir George Taubman.** Brazza, Pierre Paul François Camille Savorgnan de
**Golding, C. E.** Reinsurance (*in part*)
**Golding, Edward William.** Electricity Supply: Commercial Aspects (*in part*); Electricity Supply: Technical Aspects (*in part*); Elec-

trification, Rural (*in part*), Electric Power: National and Regional Schemes (*in part*)
**Goldschmidt, Werner.** Arbitration (*in part*)
**Goldsmith, Margaret** (Mrs Fritz A Voigt). Mesmer, Franz Anton
**Goldstone, Sir Frank W.** Educational Associations (*in part*)
**Goldthwait, Charles Francis.** Mercerizing
**Gollancz, Sir Israel.** Pearl, The
**Gomme, Lady.** Children's Games (*in part*)
**Good, Dorothy.** Japan (*in part*)
**Good, Harry Gehman.** Teachers, Training of (*in part*)
**Good, William A.** Canoe (*in part*)
**Goodenough, Florence Laura.** Atypical Children; Genius
**Goodlad, John Inkster.** Elementary Education (*in part*)
**Goodrich, Herbert F.** Judicial Reform (*in part*)
**Goodrich, Leland M.** United Nations
**Goodwin, Albert.** Barras, Paul François Jean Nicolas; Malesherbes, Chretien Guillaume De Lamoignon de, Silhouette, Etienne de
**Goodwin, Robert C.** Unemployment Insurance (*in part*)
**Gopal, Sarvepalli.** Bhopal; Keonjhar; Mandi; Murshidabad, West Bengal
**Gordon, Rev. Alexander.** Blandrata or Biandrata, Giorgio; Buckholdt, Johann; Bullinger, Heinrich, Kniperdolinck or Kniperdolling, Bernt; Servetus, Michael; Socinus; Valdes, Juan de
**Gordon, Howard Wright, Jr.** Battleship (*in part*)
**Gordon, Strathearn.** Great Britain (*in part*)
**Gorell, Lord.** Teachers Registration Council
**Gosnell, Harold Foote.** Voting
**Goss, Leonard A.** Canals and Canalized Rivers (*in part*)
**Gosse, Sir Edmund.** Anagreontics: Andersen, Hans Christian; Beaumont, Sir John; Collins, William; Donne, John; Drachmann, Holger Henrik Herboldt; Drayton, Michael; Etherege, Sir George; Fitzgerald, Edward; Gnome and Gnomic Poetry; Heroic Romances (*in part*); Herrick, Robert, Huygens, Sir Constantijn (*in part*); Kyd, Thomas (*in part*); Lie, Jonas; Norton, Thomas; Ohlenschläger, Adam Gottlob (*in part*); Prologue (*in part*); Prose (*in part*); Rimbaud, Jean Arthur; Rossetti, Christina Georgina, Stevenson, Robert Louis Balfour (*in part*); Style (*in part*); Swinburne, Algernon Charles (*in part*); Tennyson, Alfred Tennyson; Waller, Edmund (*in part*); Watson, Thomas
**Gosse, Philip,** M.D. Pirates and Piracy (*in part*)
**Gothard, William W.** Plumbing
**Gott, Philip Porter.** Confectionery Manufacture
**Gough, Alfred Bradley.** Swabian League; Westphalia, Treaty of
**Gough, Herbert John.** Fatigue of Metals; Heliotherapy
**Gould, F. A.** Barometer
**Gould, Gerald.** Wells, Herbert George
**Gould, Lieutenant Commander Rupert Thomas.** Chronometer (*in part*)
**Gould, Sydney Charles.** Novel (*in part*)
**Goulinat, Jean Gabriel.** Oil Painting, Technique of
**Graber, Laurence Frederick.** Alfalfa, Lucerne or Purple Medick
**Grace, Eugene Gifford.** Bethlehem Steel Corporation (*in part*)
**Grady, Henry Francis.** Reciprocity
**Graham, Bessie.** Nobel Prizes
**Graham, Frank D.** Gold Standard
**Graham, John.** Tonic Sol-Fa
**Graham, William.** General Strike (*in part*)
**Grainger, Paul Eveleigh.** Nickel Silver
**Grampp, William D.** Biddle, Nicholas; Carey, Henry Charles; Inter-Allied Debts; Reparations, Savings Banks
**Grand, Constantine G.** Micromanipulation or Micrurgy (*in part*)
**Grant, Bruce.** Hull, Isaac
**Grant, Brigadier General R. C.** Toc H
**Grant, William Lawson.** Brown, George, Galt, Sir Alexander Tilloch; Mackenzie, William Lyon
**Grave, Walter Wyatt.** Cambridge University
**Graves, Lawrence Murray** Aggregates Theory of, Bliss, Gilbert ... Complement; Continuity; Function, Maxima and Minima; Number Sequences, Taylor's Theorem
**Graves, Philip Perceval.** Druses (*in part*); Lebanon (*in part*); Mesopotamia (*in part*); Palestine (*in part*)
**Gray, Basil.** Binyon, (Robert) Laurence (*in part*)
**Gray, Carl Raymond, Jr.** Veterans Administration; War Pensions (*in part*)
**Gray, George Buchanan,** D D. Bible (*in part*)
**Gray, John Evelyn Bury.** Drama (*in part*)
**Gray, Sir John Milner.** Gambia (*in part*); Zanzibar (protectorate)
**Gray, Nicolette Mary.** Binyon, (Robert) Laurence (*in part*)
**Gray, R. B.** Agricultural Engineering: Agricultural Power and ... (*in part*); Harvesting Machinery; Planting Machinery; Processing Machinery, Spraying and Dusting Machinery; Tillage Machinery; Tractors (*in part*)
**Greaves, W. M. H.** Photometry (*in part*)
**Green, Lois Angell.** Spencer, Anna Garlin
**Green, Margaret M.** Education, History of (*in part*)
**Green, Marjorie E.** Family (*in part*)
**Green, Nathan.** Injunction (*in part*)
**Green, William.** American Federation of Labor
**Greenaway, Eric Stanley.** Deaf and Hard of Hearing; Education of (*in part*)
**Greene, David (William).** Irish Language; Irish Literature (*in part*)
**Greenish, Henry George.** Pharmacy (*in part*)
**Greenwood, Rt. Hon. Arthur.** Trades Union Congress, The (*in part*)
**Gregg, Allan,** M.D. Medical Education
**Gregg, Isaac.** Government Departments (*in part*); Post and Postal Services (*in part*)
**Gregg, John Frank.** Birmingham (*in part*)
**Gregory, Charles O.** Labour Law (*in part*)
**Gregory, John Walter.** Africa (*in part*)
**Gregory, Sir Theodor E. G.** Fiduciary Issue; Panic (*in part*); Quantity Theory of Money
**Gregory, Theophilus Stephen.** Roman Catholic Church (*in part*)
**Gregory, William Benjamin.** New Orleans (*in part*)
**Gregory, William King.** Mammalia; Marsupialia (*in part*); Monotremata; Perissodactyla; Primates (*in part*); Ungulata
**Greisen, Kenneth.** Cosmic Rays
**Grenfell, Sir Wilfred T.,** M.D. Labrador (*in part*)
**Gretton, R. H.** English History (*in part*)
**Greville, Thomas Nall Eden.** Life Tables
**Grey, Egerton C.** Fermentation
**Grey, Francis Temple.** Capital Punishment (*in part*); Coroner; Extradition (*in part*); Insanity in Law (*in part*); Medical Jurisprudence (*in part*)
**Grey, Ian.** Russia (*in part*)
**Grieve, Rev. Alexander James,** D.D. Catechism (*in part*); Logos (*in part*); Preaching; Primitive Methodists (*in part*); Septuagint, The; Smyth (or Smith), John (*in part*); Swedenborg or Swedberg, Emanuel (*in part*); Ursula, St. (*in part*)
**Grieve, William Percival.** Chancery (*in part*)
**Griffin, H. W.** Shipping: War Losses of (World Wars I and II) (*in part*)
**Griffin, James B.** Serpent Mound, Great
**Griffin, John Robert.** British Legion
**Griffin, W. Lashford.** Chain Manufacture (*in part*)
**Griffith, Francis Llewellyn.** Busiris; Coptic Language; Demotic Language and Writing; Egypt (*in part*); Egyptian Language; Hieroglyphs; Meroe; Meroitic Language and Writing; Moeris, Lake of; Nubian Language and Writing, Obelisk; Pharaoh; Psammetichus, Scarab (*in part*), Sphinx (*in part*); Thebes (*in part*)
**Grigg, Hubert Francis Cawdron.** Oil Palm
**Griggs, Laura T.** Valley of Ten Thousand Smokes
**Grim, Ralph Early.** Argillite; Shale
**Grimwood, Herbert H.** Wood-Carving (*in part*)
**Grinker, Roy R.,** M D. Psychiatry (*in part*)
**Grinter, Linton E.** Engineering (*in part*); Sand-Blasting and Shot Peening; Wheel, Windlass
**Grogan, Elinor F. B. (Lady Grogan).** Bulgaria (*in part*)
**Groom, Percy.** Dry Rot, Timber, Wood
**Gropius, Walter Adolph.** Architectural Education (*in part*)
**Gross, Charles.** Guilds
**Gross, Eric T. B.** Electricity Supply: Technical Aspects (*in part*)
**Gross, Leo.** Congress, International; Fried, Alfred Hermann (*in part*)
**Grossman, Morton I.,** M D. Medical Research
**Grosvenor, Gilbert Hovey.** National Geographic Society (*in part*)
**Grout, Frank F.** Barrell, Joseph (*in part*)
**Grove, Vernon Guy.** Differential Geometry
**Grover, Wayne C.** National Archives, The
**Gruening, Ernest,** M.D. Alaska (*in part*)
**Gruenthaner, Michael Joseph,** S J. Angel
**Gruffydd, William John.** Welsh Literature
**Grundy, George Beardoe.** Graeco-Persian Wars; Greece (*in part*)
**Gruner, John W.** Taconite
**Gruson, M.** Est de France, Compagnie des Chemins de Fer de L'
**Guérin, Basil Campbell de.** Guernsey
**Guice, C. Norman.** Honduras (*in part*)
**Guild, David Alexander.** Arbitration (*in part*)
**Guilday, Right Reverend Monsignor Peter.** Roman Catholic Church (*in part*)
**Guillaume, M.** Lyautey, Louis Hubert Gonzalve; Nivelle, Robert George
**Guillebaud, Claude William.** Luxury (*in part*); Luxury Taxes (*in part*); Malthus, Thomas Robert (*in part*); Marshall, Alfred (*in part*)
**Gulick, Luther Halsey.** Brooklyn (*in part*); Long Island (*in part*); Mayor (*in part*); Municipality (*in part*); New York (City) ... Staten Island
**Gulliksen, Harold.** Learning; Memory
**Gummer, C. F.** Triangle
**Gunther, Robert Theodore.** Armilla or Armillary Sphere; Astrolabe; Dial and Dialling (*in part*)
**Guthmann, Harry G.** Financial Statements
**Guttridge, George H.** Whig and Tory
**Guyer, Michael Frederic.** Birth Control; Reproduction (*in part*)
**Gwynn, Denis Rolleston.** Ireland (*in part*); Ireland, Republic of (*in part*)
**Gwynn, Stephen Lucius.** Collins, Michael, Cosgrave, William Thomas (*in part*); Griffith, Arthur; Healy, Timothy Michael
**Gwynne, Major F. W. W.** Lena Goldfields Limited (*in part*)

**Haakonsen, Daniel Andreas.** Norwegian Literature (*in part*); Novel (*in part*)
**Haas, Fritz.** Pearl (*in part*)
**Haas, William Herman.** Chile (*in part*)
**Haberler, Gottfried.** Quota
**Hack, John Tilton.** Wind
**Hackett, Charles Wilson.** Mexico (*in part*)
**Hackin, Joseph.** Tibetan Art
**Hackworth, Green H.** International Court of Justice
**Haddon, Alfred Cort.** New Guinea (*in part*)
**Hadow, Sir William Henry.** Bach, Karl Philipp Emanuel; Haydn, Franz Joseph; Schubert, Franz Peter
**Hagedorn, Hermann.** Roosevelt, Theodore
**Hahn, Mannel.** Philately
**Hahn, Richard David,** M.D. Venereal Diseases (*in part*)
**Hahne, Ernest Herman.** War Finance: Cost of World Wars I and II

**Haig, Lieutenant Colonel Sir Thomas Wolseley.** Afghanistan (*in part*)
**Halcrow, Elizabeth M.** Newcastle upon Tyne
**Haldane, John Burdon Sanderson.** Heredity (*in part*)
**Hale, Edward Everett.** Clarke, James Freeman; Everett, Edward
**Hale, George Ellery.** Spectroheliograph
**Hale, Robert Lee.** Compensation (*in part*)
**Halecki, Oskar.** Poland (*in part*)
**Halford, Jeannette.** Baby-Farming (*in part*); Foundling Hospitals (*in part*)
**Hall, Sir Alfred Daniel.** Agricultural Organization (*in part*), Agriculture A General Survey (*in part*)
**Hall, Harry Reginald Holland.** Archaeology (*in part*), Chronology (*in part*); Dress (*in part*), Egypt (*in part*); Scarab (*in part*); Sphinx (*in part*)
**Hall, Jerome.** Criminal Law (*in part*)
**Hall, R. Dawson.** Anthracite (*in part*)
**Hall, Richard B.** Title Insurance or Guarantee of Title
**Hall, Colonel Robert Burnett.** Haiti (*in part*); Santo Domingo (*in part*)
**Hall, Sir William Clarke.** Borstal System; Children's Courts or Juvenile Courts (*in part*), Probation
**Hallett, R. L.** Lead
**Halliday, Frank W.** Martial Law (*in part*)
**Halliday, Sir William Reginald.** Folklore
**Halliwell, W. J. T.** Pilotage Laws (*in part*)
**Halm, George N.** Exchange, Foreign
**Halphen, Louis.** Anjou (*in part*); Fulk Nerra
**Halstead, Paul B.** Cotton and the Cotton Industry (*in part*)
**Hamburger, Viktor.** Experimental Embryology; Regeneration
**Hamer, Sam Hield.** Monuments, Preservation of (*in part*)
**Hamilton, A. R.** Quarter-Staff; Single-Stick
**Hamilton, Mary Agnes.** MacDonald, James Ramsay; Webb, Sidney James and Beatrice
**Hamilton, Peter Davidson Gunn.** Docks (*in part*)
**Hamlin, Talbot Faulkner.** Amphitheatre; Apse; Arcade; Arch; Atrium; Baldachino; Basilica; Baths; Battlement; Buttress; Byzantine and Romanesque Architecture; Campanile; Capital; Ceiling; Château; Chimney (*in part*); Column, Crypt; Decorated Period; Diaconicon; Dome; Door; Doorway; Early English Period, Erechtheum; Flamboyant Style; Flute (*in part*), Fountain; Fret; Gothic Architecture; Governmental Architecture; Half-Timber Work; Hall; House, Hypaethrus; Lotus (*in part*); Louis Styles; Manor House; Minaret; Mosque, Moulding; Order; Panel; Perpendicular Period; Persian Art, Painting and Calligraphy (*in part*); Plateresque; Porch; Renaissance Art; Romanesque Art; Rosette; Rose Window or Wheel Window; Screen (*in part*); Shaft; Spire; Stair; Staircase, Stone Work; Sudatorium, Temple; Tile; Tomb; Tower; Tracery (*in part*); Triforium; Triumphal Arch; Tudor Period; Vault; Window
**Hammer, S. C.** Drama (*in part*); Norwegian Literature (*in part*)
**Hammick, Dalziel Llewellyn.** Benzidine (*in part*)
**Hammond, Bray.** Banking (*in part*)
**Hammond, John Lawrence Le Breton.** Industrial Revolution, The
**Hamor, William Allen.** Motor Car Engines: Their Operation and Care (*in part*); Research, Industrial (*in part*)
**Hampden, Walter.** Booth, Edwin Thomas
**Hand, Irving F.** Sunshine
**Handley, Louis de Breda.** Swimming (*in part*)
**Haney, Thomas V.** Baseball (*in part*); Mountaineering (*in part*); Ski; Walking Races; Weight Throwing; Yachting (*in part*)
**Hannay, David.** Abbadides; Alphonso I; Bainbridge, William, Byng, John; Dahlgren, John Adolf, Fisher, John Arbuthnot Fisher, 1st Baron (*in part*), Fox, Charles James (*in part*), Impressment, Junius (*in part*); Lissa, Nelson, Horatio Nelson, Viscount (*in part*), Pepys, Samuel (*in part*), St Vincent, John Jervis, St Vincent, Battle of, Sluys (Slois), Battle of; Spinola, Ambrose
**Hansen, Harry.** Lawson, Victor Fremont
**Hansen, Robert W.** Friendly Societies (*in part*)
**Hanton, W. A.** Weaving (*in part*)
**Harada, Jiro.** Bon-Seki, Dance (*in part*); Interior Decoration (*in part*), Ivory Carving (*in part*), Japanese Architecture; Japanese Gardens, Japanese Music, Japanese Sculpture; Nō Drama (*in part*), Societies of Art (*in part*); Tea Ceremony, Wood-Carving (*in part*)
**Harap, Henry.** School and Curriculum (*in part*)
**Hardenbergh, J. G., V.M.D.** Pleuropneumonia
**Hardenbergh, William Andrew.** Refuse Disposal, Sewage Disposal
**Hardin, Charles Meyer.** Government Departments (*in part*)
**Harding, Lowry W.** Illiteracy
**Hardman, Oscar, D.D.** Fasting
**Hardy, Arthur C.** Colour
**Hargrove, William Henry.** Consolidated School (*in part*)
**Harmer, Sir Sidney Frederic.** Cetacea (*in part*); Polyzoa (*in part*); Pterobranchia (*in part*)
**Harnack, Adolf von.** Millennium; Neoplatonism (*in part*); Origen; Sabellius, Theodore of Mopsuestia (*in part*); Theodoret (*in part*)
**Harned, Herbert Spencer.** Solutions
**Harper, Francis.** Wildlife Conservation and Management (*in part*)
**Harper, Ida Husted.** Women's Suffrage (*in part*)
**Harper, John Ernest Troyte.** Falkland Islands, Battle of; "Goeben" and "Breslau"; Navigation (*in part*)
**Harper, Robert Brinton.** Gas Manufacture (*in part*)
**Harrar, Ellwood Scott.** Acacia; Ailanthus; Alder; Arborvitae; Arbutus; Ash, Aspen; Athel; Basswood; Beech; Birch; Blackhaw; Cedar, Chinquapin; Cypress; Dogwood; Douglas-Fir; Fir; Hackberry; Hawthorn; Hornbeams; Horsechestnut (*in part*); Juniper; Larch; Lime or Linden, Maple; Mesquite; Mountain Ash; Palo Verde, Persimmon (*in part*); Pine (*in part*); Sycamore; Tree (*in part*); Tuliptree
**Harris, Abram Lincoln.** Sombart, Werner
**Harris, Enriqueta.** Navarrete, Juan Fernandez de; Zuloaga, Ignacio; Zurbaran, Francisco de
**Harris, Frederic Robert.** Harbours (*in part*)
**Harris, George Christe.** Abietic Acid
**Harris, Marshall Dees.** Land Tenure: Economic and Agrarian Aspects (*in part*)
**Harris, Walter Burton.** Abdel Krim
**Harrison, Austin.** Harrison, Frederic
**Harrison, Earl Grant.** Naturalization Laws
**Harrison, Frederic.** Ruskin, John
**Harrison, George Leslie.** Federal Reserve System, The (*in part*)
**Harrison, H. Ainsworth.** Fluorene
**Harrison, H. S.** Material Culture
**Harrison, James C.** Horse Racing and Breeding (*in part*)
**Harrison, Colonel Lawrence Whitaker.** Salvarsan or "606" (*in part*)
**Harrison, Robert William F.** Royal Society, The (*in part*); Violin (*in part*)
**Harrisson, Tom.** Borneo (*in part*)
**Harrod, R. F.** Malthus, Thomas Robert (*in part*)
**Hart, Albert Bushnell.** United States (of America), The (*in part*)
**Hart, Albert Gailord.** Depreciation (*in part*); National Savings (*in part*)
**Hart, Donald J.** Hours of Labour (*in part*)
**Hart, James.** Administrative Law; Authority, Administrative
**Hart, John Henry Arthur.** Asmoneus or Asamonaeus; Josephus, Flavius (*in part*); Sibylline Oracles (*in part*)
**Hartman, Olga.** Annelida (*in part*)
**Hartney, Harold Evans.** Observation Corps in Air Defense (*in part*), Pursuit
**Hartung, Maurice Lee.** Secondary Education (*in part*)
**Harvey, E. Newton.** Bioluminescence
**Harvey, Ethel Browne.** Fertilization
**Harvey, F. T.** Veterinary Science (*in part*)
**Harvey, Godfrey Eric.** Burma (*in part*); Burmese Wars
**Harvey, Samuel C., M D** Surgery
**Harvey, Thomas Edmund.** Fox, George
**Haseloff, Arthur.** Illuminated Manuscripts
**Hass, Henry Bohn.** Charcoal
**Hasselkus, J.** Binocular Instrument (*in part*)
**Hastings, Somerville.** Sinus (*in part*)
**Hatch, Frederick Henry.** China-Clay (*in part*); Ilmenite; Kaolinite
**Hathway, Marion.** Social Service
**Hatschek, Emil.** Viscosity
**Hauck, Albert, D.Th.** Church History (*in part*)
**Haughton, John L.** Metals
**Haurwitz, Bernhard.** Winds, General Circulation of
**Hauser, Philip M.** Production, Census of (*in part*)
**Haust, Jean.** Walloon Literature
**Haven, Charles T.** Colt, Samuel
**Haverfield, Francis John.** Boadicea; Britain (*in part*); Caledonia (*in part*); Ermine Street, Gaul (*in part*); Numantia, Roman Army; Trinovantes
**Haward, Edwin.** India (*in part*); Punjab (*in part*); Sind (*in part*); United Provinces (*in part*)
**Hawk, W. W.** Diamond Match Company, The
**Hawkes, Frederic Clare.** Estate and House Agents
**Hawkins, George Andrew.** Engineering Education (*in part*)
**Haworth, Walter Norman.** Carbohydrates (*in part*)
**Hawtrey, Ralph George.** Civil List (*in part*); Exchequer (*in part*); Finance
**Hayakawa, S. I.** Korzybski, Alfred Habdank Skarbek; Semantics
**Hayes, Carlton Joseph Huntley.** Gelasius (*in part*); Guibert or Wibert; Lucius (*in part*); Matilda, countess of Tuscany; Paschal II; Sixtus IV (*in part*); Truce of God; Victor (*in part*)
**Hays, Arthur Garfield.** Theatres, Laws Relating to (*in part*)
**Hayward, Herman Eliot.** Fruit; Leaf (*in part*); Root; Seed; Stem
**Haywood, Harold Le Roy.** Freemasonry (*in part*)
**Hazard, John Newbold.** Communist Party
**Hazeltine, Mary Emogene.** Christmas (*in part*)
**Headlam, Rt. Rev. Arthur Cayley, D.D.** Prayer, Book of Common (*in part*)
**Headlam-Morley, Agnes.** Stresemann, Gustav
**Headlam-Morley, James Wycliffe.** Benedetti, Vincent; Caprivi de Caprera de Montecuccoli, Georg Leo Von
**Healy, John J., S.J.** Episcopacy
**Heath, Dudley.** Art Teaching (*in part*)
**Heath, Sir Thomas Little.** Apollonius of Perga; Archimedes; Diophantus; Euclid; Heracleides, Ponticus; Heron of Alexandria; Nicomachus; Pappus of Alexandria; Porism; Ptolemy (*in part*); Pythagoras; Serenus; Theodosius
**Heaton, Herbert.** Factory Production, History of; Market (*in part*)
**Heawood, Edward.** Elgon
**Heckel, George Baugh.** Interior Decoration (*in part*)
**Hedges, J. Edward.** Insurance (*in part*)
**Hedgpeth, Joel Walker.** Pycnogonida
**Hedin, Göran.** Sweden (*in part*)
**Hedley, Frank.** Interborough Rapid Transit Company
**Hedley, Rt. Rev. John Cuthbert, O.S.B., D.D.** Transubstantiation (*in part*)
**Heffernan, Rear Admiral John B.** Constitu-

tion; Navigation (*in part*), Sloop; United States (of America), The (*in part*); Yacht
**Heffner, Hubert Crouse.** Melodrama
**Heidbreder, Edna.** Thinking. Psychology of
**Heighway, Arthur J.** Advertising (*in part*)
**Heiland, Carl August** Geophysical Prospecting (Geophysical [illegible] Geo-[illegible]
**Heilbrunn, Lewis Victor.** Acclimatization
**Hein, M. A.** Ensilage
**Heine-Geldern, Robert von.** Indonesia·Archaeology (*in part*)
**Heinemann, Martin,** M D Tongue, Diseases of
**Heinicke, A. J.** Fruit Farming (*in part*)
**Heise, George William.** Battery (*in part*)
**Heldt, Peter Martin.** Speedometers, Tractors (*in part*)
**Hele-Shaw, Henry Selby.** Power Transmission (*in part*)
**Heller, Walter W.** Excess-Profits Tax (*in part*), Surtax; Taxation
**Heller, Wilfried.** Crystalloid; Emulsions; Gel
**Helms, Hermann.** Chess (*in part*)
**Hempelmann, Friedrich.** Psychology, Comparative
**Hench, Philip Showalter,** M D Osteoarthritis
**Henderson, A. F.** Fireproofing (*in part*)
**Henderson, Archibald.** Shaw, George Bernard
**Henderson, Bernard William.** Peloponnesian War, The
**Henderson, Charles Belknap.** Reconstruction Finance Corporation (*in part*)
**Henderson, K.,** D D. Beja (*in part*)
**Henderson, Leon.** War Organizations, U.S. (World War II) (*in part*)
**Hendrick, Burton Jesse.** Page, Walter Hines
**Hendrick, Ives,** M.D. Psychiatry (*in part*)
**Henne, Albert Leon.** Freon
**Hennessy, Harriet L.,** M D. Intestinal Obstruction; Plague (*in part*)
**Henningsen, Sven.** Denmark (*in part*)
**Henry, Robert Mitchell.** Drama (*in part*)
**Henry, Robert S.** Railways (*in part*)
**Henry, Thomas Anderson.** Alkaloids; Cinchona Bark, Alkaloids of (*in part*); Glucosides, Natural
**Henson, The Rt. Rev. Herbert Hensley,** Hon. D D. Bible, English (*in part*); Church and State
**Hepburn, Patrick Bruce.** Bookselling (*in part*)
**Herbert, Sydney.** Syndicalism (*in part*)
**Herbert, William de Bracy.** Arrest (*in part*); Bail (*in part*); Bigamy; Blackmail (*in part*); Bribery (*in part*), Habitual Offenders (*in part*); Incest; Infanticide (*in part*); Intent; Larceny (*in part*); Obscenity (*in part*); Quarter Sessions, Court of (*in part*); Riot (*in part*); Treason (*in part*)
**Herdman, Thomas.** Arabia (*in part*); Black Sea (*in part*); Crimea (*in part*); Czechoslovakia (*in part*); Elbe; Guiana (*in part*); Hunter River; Ireland (*in part*); Mediterranean Sea (*in part*), North Sea; Persia (*in part*); Prussia (*in part*); Russia (*in part*); Wash, The; Yugoslavia (*in part*); Zuider Zee (*in part*)
**Hermannsson, Halldor.** America (*in part*); Vinland or Wineland
**Herndon, Arthur H.** Sugar (*in part*)
**Herold, Edward William.** Electron Tube
**Heron, Harold.** Starch (*in part*)
**Herr, Major General John Knowles.** Cavalry (*in part*)
**Herr, Major Milton B.** Artillery (*in part*); Coast Defense; Field Artillery; Gas Mask; Guerrilla Warfare (*in part*); Smoke In Warfare; United States (of America), The (*in part*)
**Herrick, C. Judson.** Evolution, Organic (*in part*)
**Herrick, Horace Terhune.** Chemurgy
**Herriot, Edouard.** Danton, Georges Jacques; Jaures, Auguste Marie Joseph Jean
**Hershberg, Emanuel Benjamin.** Chemical Apparatus
**Hervey, John L.** Horse; Horse Racing and Breeding (*in part*)
**Herzberg, Max John.** Crane, Stephen
**Herzfeld, Ernest Emil.** Persepolis (*in part*)
**Hespelt, E. Herman.** Spanish-American Literature
**Hess, Julius Hays,** M.D. Antenatal Clinics
**Hesse, Richard.** Distribution of Animals (*in part*)
**Hessels, John Henry.** Gloss and Glossary (*in part*), Gutenberg, Johann (*in part*)
**Hesseltine, William B.** Wisconsin (*in part*)
**Heuser, Chester Henry.** Embryology, Human (*in part*)
**Hevesy, George Charles de.** Hafnium
**Hewins, William Albert Samuel.** Protection (*in part*)
**Hewitt-Myring, Philip.** Barbados
**Hewson, Edgar Wendell.** Baroclinic; Barotropic; Coriolis, Gaspard Gustave de; Ekman Spiral; Fronts; Geostrophic Wind; Humidity, Atmospheric; Inertia Motion; Motion, Laws of (*in part*)
**Heyneman, Julie Helen.** Sargent, John Singer
**Heywood, Lieutenant Colonel T. G. G.** Serbian Campaigns
**Hiatt, Walter Sanders.** Circulars and Circularizing, Clubs (*in part*)
**Hibbert, Eva.** Bleaching; Calico Printing; Dyeing; Textile Printing (*in part*)
**Hickman, Clarence N.** Rockets (*in part*)
**Hickman, Kenneth Claude Devereux.** Distillation (*in part*)
**Hickock, Harold C.** Elevators; Escalator
**Hicks, Agnes H.** Sweden (*in part*)
**Hicks, George Dawes.** Knowledge, Theory of
**Hicks, Granville.** Steffens, Lincoln
**Hicks, John Donald.** Wisconsin (*in part*)
**Hicks, Robert Drew.** Stoics
**Higginson, J. Vincent.** Mass (*in part*)
**Hightower, John.** Camping (*in part*); Greyhound Racing (*in part*)
**Hildebrand, Joel Henry.** Chemical Equilibrium
**Hildebrand, Karl.** Sweden (*in part*)
**Hildebrand, Samuel Frederick.** Salmonidae
**Hilfer, Harry.** Cosmetics (*in part*)
**Hill, Archibald Vivian.** Muscle and Muscular Exercise
**Hill, Sir George Francis.** Numismatics (*in part*)
**Hill, James Brents.** Louisville and Nashville Railroad Company
**Hill, John Eric.** Alpaca (*in part*); Antelope; Artiodactyla: Bat; Beaver, Bobcat; Bovidae; Caenolestid, Carnivora (*in part*), Cat; Chimpanzee; Chipmunk; Chiroptera; Clouded Leopard; Coyote; Diana Monkey; Dingo or Warrigal (*in part*); Dormouse; Drill, Dromedary; Ermine, Fyre, Flying Squirrel, Fossa, Fox (*in part*); Genet; Goral; Grison, Grivet; Grizzly Bear; Ground Squirrel Guenon, Guinea Pig; Ichneumon; Indri; Insectivora (*in part*); Jaguarondi, Jumping Hare, Jumping Mouse, Kangaroo Rat; Kra; Linsang; Marten; Monkey; Mouflon or Muflon; Musk Ox; Muskrat; Ocelot; Patas or Hussar Monkey; Palm Civet, Panda, Peccary; Pika; Pocket Mouse; Prairie Dog, Primates (*in part*); Ratel, Rodent, Rodentia; Sea Cow; Sea Elephant, Sea Lion; Shrew; Tarsier; Thylacine or Marsupial Wolf; Tiger Cat; Tree Shrew; Viscacha; Water Deer; Wapiti; Zebra; Zorilla
**Hill, Sir Leonard Erskine.** Aerotherapeutics; Kata Thermometer; Light and Radiation in Relation to Health
**Hill, Norman Llewellyn.** Annexation; Boundaries; Hinterland
**Hillier, James.** Electron Microscope; Electron Microscopy
**Hills, Edwin Sherbon.** Australia (*in part*)
**Hills, John Moore.** Salt (*in part*)
**Hills, Nina L. (Hon. Mrs. Eustace Hills).** Day Nurseries (*in part*)
**Hilton, John.** Amalgamation (*in part*); Combination in Industry; Gentlemen's Agreements; Monopoly; Pools, in Industry (*in part*); Profit-Sharing (*in part*); Rebates, Deferred; Trusts (*in part*)
**Hind, Arthur M.** Engraving
**Hines, William M., Jr.** War Graves (*in part*)
**Hinkle, Charles W.** Camouflage; Cavalry, Chasseurs; Engineers, Military (*in part*); Flame Thrower, Grenades; Mountain Warfare; Training Camps, U S Military
**Hinnebusch, William Aquinas.** Tetzel, Johann; Torquemada, Thomas
**Hipkins, Alfred J.** Pitch, Musical (*in part*)
**Hippisley, Colonel Richard Lionel.** Linkages
**Hirn, Yrjo.** Finnish Literature (*in part*)
**Hirsch, Emanuel,** D.Th. Creeds (*in part*)
**Hirsch, Helmut.** Campo Formio, Peace of; Gastein, Convention of; Gerlach, Hellmut von; Mercenary, Pirmasens; Saarland
**Hitchcock, Eldred Frederick.** Wool, War Control of
**Hitti, Philip Khuri.** Arabia (*in part*); Hadhramaut (*in part*); Hasa (*in part*), Jidda (*in part*), Kuwait (*in part*), Maronites, Mecca (*in part*); Yemen (*in part*)
**Hoagland, Henry E.** Building Societies (*in part*)
**Hobday, Sir F. T. G.** Canine Distemper
**Hobhouse, Leonard T.** Comparative Ethics
**Hobson, Charles Kenneth.** Profiteering (*in part*)
**Hobson, Oscar Rudolf.** Money Market (*in part*); Wealth
**Hobson, Robert Lockhart.** Pottery and Porcelain (*in part*)
**Hobson, Wilder.** Jazz
**Hocking, William Ernst,** D.D. Royce, Josiah (*in part*)
**Hodge, Edward Butler.** Nitro Compounds
**Hodge, Frederick Webb.** Cliff-Dwellings; Scalping
**Hodges, Paul C.,** M.D Radiology (*in part*)
**Hodgkin, Major Adrian Elliot.** Alkali Manufacture (*in part*); Chlorine, Soda
**Hodgkin, Thomas.** Alaric (*in part*), Ravenna (*in part*); Vandals
**Hodgkinson, William R.** Picric Acid or Lyddite
**Hodous, Lewis,** D.D., B.D. Confucianism; Taoism
**Hodson, William.** Children—Protective Laws (*in part*); Legitimacy and Legitimation (*in part*)
**Hoebel, E. Adamson.** Blood Feud
**Hoffman, Frederick J.** Psychoanalysis (*in part*)
**Hoffmann, Josef.** Art Teaching (*in part*); Interior Decoration (*in part*); Tool
**Hogan, James.** Ireland (*in part*)
**Hogarth, David George.** Aegean Civilization (*in part*), Asia Minor (*in part*); Comana; Druses (*in part*), Ephesus; Lawrence, Thomas Edward (*in part*); Schliemann, Heinrich; Sis or Kozan; Smyrna (*in part*); Xanthus
**Hogben, Lancelot T.** Cell; Chromosome; Comparative Physiology; Endocrinology (*in part*); Homology
**Hogg, Hope W.** Mesopotamia (*in part*)
**Holden, Arthur C.** House Planning (*in part*)
**Holdich, Sir Thomas Hungerford.** Chitral (*in part*), Kabul (*in part*); Kalat; North-West Frontier Province (*in part*); Quetta
**Holinger, Paul H.,** M D Laryngitis
**Holland, Sir Eardley Lancelot,** M.D. Gynaecology (*in part*)
**Holland, Raymond Prunty.** Shooting (*in part*)
**Holley, Horace.** Babiism; Baha'i Faith
**Hollingworth, Leta S.** Family (*in part*)
**Hollis, Henry Park.** Observatory (Astronomical) (*in part*); Photography, Celestial (*in part*)
**Holloway, Emory.** Whitman, Walt
**Holloway, J. W., Jr.** Medical Legislation (*in part*)
**Hollowell, E. A.** Clover; Sweetclover
**Hollweg, Admiral Carl.** Tirpitz, Alfred von (*in part*)
**Holmes, Sir Charles John.** Constable, John
**Holmes, Edward Morell.** Opium (*in part*); Pharmacopoeia
**Holmes, O. W.** Carver, Jonathan (*in part*)
**Holroyd, Sir Charles.** Legros, Alphonse (*in part*)
**Holsapple, Lloyd B.** Donation of Constantine
**Holstein, Otto.** Chan Chan; Trujillo (*in part*)

**Holtom, Daniel Clarence,** D.D. Shintoism
**Holtzheuer, William.** Continental Caoutchouc and Gutta Percha Company
**Holzman, Benjamin Grad.** Hygrometer
**Honey, William Bowyer.** Pottery and Porcelain (*in part*)
**Hood, Joseph Douglas.** Thysanoptera
**Hook, Sidney.** Proletariat
**Hooker, Davenport.** Embryos, Behaviour of (Vertebrate)
**Hooper, Franklin Henry.** Hancock, Winfield Scott; Harvard University (*in part*); Liberty Loans
**Hoover, John Edgar.** Fingerprints
**Hopkins, Sir Frederick Gowland,** Hon. M.D Cystine
**Hopkinson, Sir Alfred.** Adoption
**Hopkirk, Howard W.** Children: Protective Laws (*in part*)
**Hopper, Turner Harcourt.** Cottonseed (*in part*)
**Hopwood, Frank Lloyd.** Physics in Medicine
**Horne, Rev. Dom. E.** Glastonbury
**Horner, Fred.** Annealing; Axle; Brake; Brazing and Soldering; Buffer (*in part*); Bunsen Burner; Clutch; Condenser, Cylinder; Fan; Forging Press; Gas Meter (*in part*); Governor (*in part*); Grinding-Machines; Hydrant; Jig; Lathe; Machine-Tools (*in part*); Milling Machines; Punching and Shearing Machines; Sawing Machines; Shaft, Driving; Steam-Hammer; Steam Shovel or Navvy, Torque; Wood-Working Machinery
**Horner, J. G.** Screw; Tool
**Hose, Charles.** Banjermasin or Bandjarmasin (*in part*); Beri-Beri; Blowgun; Borneo (*in part*); Brunei (*in part*); Java (*in part*); Labuan (*in part*); Malay Archipelago (*in part*); Sumatra (*in part*)
**Hoselitz, Bert Frank.** Drachma, Finance, Articles on; Franc; Krone; Sol; [illegible] (*in part*)
**Hoster, Mrs. Constance.** Forms of Address (*in part*)
**Hough, Graham Goulder.** English Literature (*in part*)
**Hough, Henry Beetle.** Martha's Vineyard; Nantucket (*in part*)
**Hough, Jack L.** Michigan, Lake
**Houghton, A. E.** Serrano, Francisco (*in part*)
**Houghton, Henry Garrett.** Adiabatic Processes in Atmosphere; Condensation Trails; Geopotential; Hail
**House. Colonel Edward Mandell.** Paris, Conference of (*in part*)
**Houseman, C. R.** Oxygen
**Houston, William Vermillion.** Electron, The
**Hovey, Rev. Horace Carter,** D.D. Luray Cavern
**Howard, Alexander L.** Teak (*in part*)
**Howard, Harry Nicholas.** Balkan Entente, The, Little Entente (*in part*)
**Howard, Leland.** Mint (*in part*)
**Howard, Leland Ossian.** Alfalfa Weevil; Chinch Bug (*in part*), Colorado Potato Beetle; European Corn Borer (*in part*); Gypsy Moth; Harlequin Bug; Japanese Beetle; Peach Tree Borer; Plum Curculio; Woolly Apple Aphid
**Howarth, F.** Bryophyta (*in part*)
**Howarth, Osbert John Radclyffe.** London (*in part*); Norway (*in part*); Scotland (*in part*)
**Howe, John Allen.** Fuller's Earth (*in part*)
**Howe, Ronald Martin.** Scotland Yard
**Howell, Alfred Brazier.** Locomotion of Animals (*in part*)
**Howell, Benjamin Franklin.** Cambrian System
**Howell, John Thomas.** Eastwood, Alice
**Howes, Frank Norman.** Cane
**Howes, Frank Stewart.** Carol
**Howland, W. E.** Engineering (*in part*); Engineering Education (*in part*)
**Hoye, John.** Cotton and Cotton Industry (*in part*)
**Hrozný, Friedrich.** Hittites, The
**Hubbard, Eric Hesketh.** Dobson, Frank
**Hubbard, Howard Archibald.** Arizona
**Hubbard, Prevost.** Asphalt
**Hubbard, Theodora Kimball.** Landscape Architecture (*in part*)
**Hubbell, Theodore H.** Cockroach; Cricket; Earwig; Grasshopper, Grouse Locust; Katydid; Leaf Insect; Locust; Orthoptera; Stick-Insect
**Hubbs, Carl L.** Cyclostomata or Marsipobranchii; Fishes (*in part*); Hagfish; Lamprey
**Huber, Max.** Red Cross (*in part*)
**Huddleson, I. Forest.** Brucellosis
**Hudleston, F. J.** Balaclava; Crimean War (*in part*)
**Hudnut, Joseph.** Renaissance Architecture (*in part*); Sculpture (*in part*)
**Hudson, Alfred E.** Asia (*in part*)
**Hudson, E. B.** Sheets, Iron and Steel
**Hudson, Hilda Phoebe.** Analytic Geometry; Curve; Surface (*in part*)
**Hudson-Williams, Thomas.** Theognis of Megara
**Hueffer, Francis.** Handel, George Frederick (*in part*)
**Huff, Clay G.** Entomology (*in part*)
**Hügel, Baron F. von.** John (The Apostle); John, Gospel of St.
**Huggins, Maurice Loyal.** Association
**Hughan, William James.** Freemasonry (*in part*)
**Hughes, Charles Evans.** Monroe Doctrine, The
**Hughes, Rupert.** Borglum, Gutzon
**Huiskamp, Gerard Lawrence.** Boot and Shoe Industry
**Hulburt, Ray Garland.** Osteopathy
**Hull, A. Eaglefield.** Musical Notation
**Hume, Brigadier General Edgar Erskine,** M.D Society of the Cincinnati
**Humphrey, George.** Association, Mental
**Humphreys, William Jackson.** Mirage
**Humphries, Sir Albert Edward.** Middlings; Semolina
**Hungerford, Herbert B.** Bedbug, Hemiptera (*in part*); Water Boatman
**Hunsaker, Jerome Clarke.** Farman, Henri
**Hunt, Arthur Surridge.** Papyrology
**Hunt, Brigadier Sir (Henry Cecil) John.** Everest, Mount (*in part*)
**Hunt, Kenneth Edward.** Milk (*in part*)
**Hunt, Rockwell Dennis.** Los Angeles (*in part*)
**Hunt, Stanley B.** Synthetic Fibres (*in part*)
**Hunt, W. Ben.** Woodcraft
**Hunter, Arthur.** Annuity (*in part*)
**Hunter, Dard.** Watermarks
**Hunter, Sir Robert.** Commons (*in part*)
**Hunter, Walter Samuel.** Behaviourism
**Huntingford, George Wynn Brereton.** Leka, Swahili
**Huntington, Ellsworth.** Fire (*in part*)
**Hurd, Charles DeWitt.** Thiophene
**Hurlbut, Cornelius Searle, Jr.** Asbestos; Beryl; Mineralogy (*in part*)
**Hurlestone-Jones, F. R.** Training Corps, Officers' (*in part*)
**Hurren, S. A.** Pianoforte (*in part*); Pianoforte Manufacture (*in part*); Player-Piano
**Hurst, Edward Weston,** M.D. Encephalitis
**Hurst, Harold Edwin.** Kagera; Nile
**Hurst, Willard.** Lawyer (*in part*)
**Husik, Isaac.** Jewish Philosophy
**Husserl, Edmund.** Phenomenology
**Hussey, Joan Mervyn.** Basil I; Basil II, Bulgaroctonus
**Hussey, Rowland M.** Nail Manufacture
**Hutchens, Arthur R.** Football (*in part*)
**Hutchins, Ethel L.** Cincinnati
**Hutchins, Leroy W.** Canoe (*in part*)
**Hutchinson, George Evelyn.** Biology (*in part*); Palolo Worm
**Hutchinson, John.** Africa (*in part*)
**Hutchinson, Margaret Coshun.** Sororities (*in part*)
**Hutchison, A. F.** Wallace, Sir William (*in part*)
**Huth, Hans.** Museums and Art Galleries (*in part*)
**Hutton, Rev. Arthur Wollaston.** Leo XIII (*in part*); Manning, Henry Edward (*in part*); Newman, John Henry (*in part*); Wiseman, Nicholas Patrick Stephen (*in part*)
**Hutton, Edward.** Boccaccio, Giovanni
**Hutton, Eric.** Lewis, John Llewellyn (*in part*)
**Hutton, John Anthony.** Bermuda; British Commonwealth (*in part*)
**Hutton, John Henry.** Aeta; Batak; Bugis; Cynotherapy; Head-Hunting; Khasi and Jaintia Hills (*in part*), Naga Hills; Tling; Kuki; Lisu; Lolo; Lycanthropy; Meithei; Metempsychosis (*in part*), Moro, Naga Hills (*in part*), Rejang; Sakai; Semang; Shan; Talaing
**Huxford, Walter Scott.** Stroboscope
**Huxley, Julian Sorell.** Courtship of Animals; Dedifferentiation; Individuality; Metamorphosis (*in part*), Selection (*in part*)
**Hyatt, James Philip.** Jeremiah (*in part*)
**Hyde, Harold Augustus.** Wales (*in part*)
**Hyman, Libbie Henrietta.** Morphology; Rotifera (*in part*); Tapeworms (*in part*), Turbellaria (*in part*); Vertebrata, Worm, Zoology
**Hymans, Henri Simon.** Rubens, Peter Paul (*in part*), Van Dyck, Sir Anthony (*in part*)

**Ilbert, Sir Courtenay.** Evidence (*in part*)
**Imms, A. D.** Aphides (*in part*); Coleoptera (*in part*); Diptera (*in part*), Entomology (*in part*); Hemiptera (*in part*); Hymenoptera; Lepidoptera (*in part*); [illegible]; Mosquito (*in part*); [illegible]; Phylloxera; Saw-Fly; Social Insects; Tsetse Fly, Wasp; Weevil (*in part*)
**Ingalls, A. G.** Mirror (*in part*)
**Inge, Very Rev. William Ralph,** D.D. Plotinus
**Ingham, Kenneth.** Kenya (colony) (*in part*)
**Ingham, P. B.** Eurhythmics
**Inghram, Mark G.** Mass Spectroscopy (*in part*)
**Ingpen, Roger.** Shelley, Percy Bysshe (*in part*)
**Ingram, Beresford.** Continuation Schools (*in part*)
**Ingram, Henry St. John.** Whist (*in part*); Whist, Solo
**Ingram, John Kells.** Senior, Nassau William (*in part*), Slavery (*in part*)
**Ingram, Thomas Allan.** Bill of Sale (*in part*); Holiday
**Ingrams, William Harold.** Hong Kong (*in part*); Sokotra (*in part*)
**Innes, Alexander.** Knox, John
**Innes, William Thorton.** Ives, Frederic Eugene
**Innes of Learney, Sir Thomas.** Eglinton, Earls of
**Innis, Harold Adams.** Canada (*in part*)
**Inwards, H.** Straw and Straw Manufactures (*in part*)
**Iredell, Francis Willard.** Addis Ababa; Algeria (*in part*, Travellers (*in part*); Angola (*in part*), Asmara; Benghazi (*in part*); Congo Free State (*in part*); Eritrea (*in part*); Fez; Fezzan, Iraq (*in part*); Jibuti, Kantanga; Massawa; Mesopotamia (*in part*); Misurata; Oran; Quilimane, Rhodesia (*in part*); Ruanda-Urundi (*in part*); Somaliland, Tanga, Tobruk; Transvaal (*in part*); Tunis (*in part*), Tunisia (*in part*); Wazzān
**Ironside, Field Marshal Sir William Edmund.** Russia, Campaign in North (*in part*); Russo-Polish Campaign; Tannenberg, Battle of
**Irvine, William Fergusson.** Liverpool (*in part*)
**Irving, Frederick A.** West Point (*in part*)
**Irwin, Brian St. George.** Land Description (*in part*)
**Irwin, Robert Benjamin.** Blindness (*in part*)
**Irwin, Will.** Baseball (*in part*)
**Irwin, William A.** Wisdom Literature
**Isaac, Jules.** Anne (of France); Francis I (*in part*)
**Isaacs, Jacob.** Dramatic Criticism
**Isaacs, S. C.** Theatres, Law Relating to (*in part*)
**Izard, Thomas C.** Whetstone, George

**Jack, George.** Sculpture Technique (*in part*)
**Jackson, Dunham.** Polynomial (*in part*)
**Jackson, Edna.** Health Visitor (*in part*)
**Jackson, Henry.** Parmenides of Elea; Sophists; Thales of Miletus (*in part*); Xenocrates of Chalcedon (*in part*)
**Jackson, Sir Herbert.** Microscopy (*in part*)
**Jackson, John.** Moon, Planetarium

**Jackson, John Hampden.** Finland (*in part*)
**Jackson, Major General Sir Louis (Charles).** South African War, 1899-1902 (*in part*)
**Jackson, Stanley Percival.** South Africa, Union of (*in part*)
**Jacob, George James Morley.** Juvenile Delinquency (*in part*)
**Jacobs, Rev. Charles Michael, D D** Lutherans (*in part*)
**Jacob. Ernest Fraser.** History (*in part*)
**Jacobs, Joseph.** Jew, The Wandering (*in part*); Passover (*in part*)
**Jacobson, Nathan.** Polynomial (*in part*); Ring (*in part*)
**Jadwin, Edgar.** Champlain, Lake, Colorado River; Erie, Lake (*in part*), George, Lake; Hudson River, Missouri River; Niagara River, Ontario, Lake (*in part*), Saint Clair River (*in part*)
**Jaffe, Lee K.** Port Authority (*in part*)
**Jakl, Vincent E.** Kite-Flying (*in part*)
**James, Charles.** Holmium; Neodymium; Samarium, Terbium; Thulium; Ytterbium; Yttrium
**James, E. Ibbetson.** Aytoun, William Edmonstoune, Chesterton, Gilbert Keith, Chevalier, Albert, Lloyd, Marie
**James, F. E. Skone.** Copyright (*in part*)
**James, Harlean.** Washington
**James, Milton Carl.** Pisciculture (*in part*)
**James, Montague R.** Eton
**James, Richard Edward Warwick.** Coques, Gonzalez, Koninck, Philips; Neer, Van Der; Ostade
**James, William P.** Kipling, Rudyard (*in part*)
**Jamot, Paul.** Painting (*in part*)
**Janson, Roland Godfrey.** Skating
**Javarek, Vera.** Serbo-Croatian Literature
**Jayne, Kingsley Garland.** Malay Archipelago (*in part*)
**Jeans, Sir James Hopwood.** Cosmogony; Kinetic Theory of Matter (*in part*), Relativity (*in part*)
**Jebb, Sir Richard Claverhouse.** Aristophanes (*in part*), Demosthenes; Greek Literature (*in part*); Isocrates (*in part*), Lysias (*in part*); Pindar (*in part*); Rhetoric (*in part*); Thucydides (*in part*)
**Jeffers, William Martin.** Union Pacific Railroad (*in part*)
**Jefferson, [illegible] Spinal** Column, Surgery of
**Jefferson, [illegible]** (*in part*)
**Jeffery, H. E.** Goat (*in part*)
**Jeffreys, Harold.** Earth
**Jeffries, Zay.** Alloys
**Jellison, William L.** Bird Louse; Louse
**Jenkins, Evan David Thomas.** Constitution of Athens
**Jenkins, Francis Arthur.** Light (*in part*)
**Jenkins, Hilger Perry, M D** Appendicitis
**Jenkins, Robert Thomas.** Wales (*in part*)
**Jenkinson, Sir Hilary.** Exchequer (*in part*); Tally
**Jenks, William Jackson.** Norfolk & Western Railway Company, The
**Jenne, Eldon I.** Physical Education
**Jenness, Diamond.** Eskimos; Ivory Carving (*in part*)
**Jennings, Walter W.** Kentucky (*in part*)
**Jennings, William Ivor.** Ministry; Speaker (*in part*)
**Jespersen, Otto.** Grammar; Philology
**Jessup, Walter Albert.** Iowa (*in part*)
**Jevons, William Stanley.** Boole, George
**Johannesson, Thorkell.** Iceland (*in part*)
**Johannsen, Albert.** Diabase; Dolerite
**Johns, Iral Brown.** Calomel; Corrosive Sublimate; Mercury
**Johnson, A. Le Roy.** Orthodontia
**Johnson, Earl Shepard.** Civics
**Johnson, Edward C.** Embalming
**Johnson, Emory Richard.** Inter-State Commerce; Transport (*in part*)
**Johnson, Frank William.** Oak (*in part*)
**Johnson, James Weldon.** Negro, The American (*in part*)
**Johnson, Martin Wiggo.** Marine Biology; Ocean and Oceanography (*in part*); Zoological Collecting (*in part*)
**Johnson, O. M.** Farm Rents (*in part*)
**Johnson, Raymond.** Softball
**Johnson, Thomas Hope.** Chronographs (*in part*); Electricity, [illegible]
**Johnson, Warren C.** [illegible] Clayton
**Johnson, W[illegible]** [illegible]lena, Paramecium, [illegible]
**Johnston, Alexander.** United States (of America), The (*in part*)
**Johnston, Charles.** Song Birds (*in part*)
**Johnston, Charles Haven Ladd.** McClellan, George Brinton
**Johnston, Sir Harry Hamilton.** Africa (*in part*); Liberia (*in part*), Uganda (*in part*)
**Johnston, Henry Phelps.** American Revolution, The (*in part*)
**Johnston, Paul E.** Farm Management (*in part*)
**Johnston, Walter Henry.** Great Britain (*in part*)
**Jolas, Maria.** Drama (*in part*)
**Joliot-Curie, Irène.** Polonium (*in part*)
**Joll, James Bysse.** Germany (*in part*)
**Jolliffe, Arthur Ernest.** Series (*in part*)
**Jolowicz, Herbert Felix.** Roman Law
**Joly, Charles Jasper.** Camera Lucida
**Jones, Sir Bennett Melvill.** Aerodynamics
**Jones, E. Alfred.** Golden Rose (*in part*), Mace (*in part*), Silversmiths' and Goldsmiths' Work (*in part*)
**Jones, Ernest, M.D** Freud, Sigmund (*in part*)
**Jones, E. Taylor.** Electromagnet (*in part*); Induction Coil
**Jones, Frederic Wood.** Australia (*in part*)
**Jones, Gilbert Starling.** Valley Forge
**Jones, Gwilym Peredur.** Freemasonry (*in part*)
**Jones, Sir Harold Spencer.** Astronomy (*in part*); Astrophysics; Telescope (*in part*); Star (*in part*)
**Jones, Henry Albert.** Potato (*in part*)
**Jones, J. C. Griffith.** Eisteddfod; Wales (*in part*)
**Jones, Jenkin William.** Rice (*in part*)
**Jones, Percy Herbert.** Cremation (*in part*)
**Jones, Philip James.** Farnese, Sforza, Sforza, Caterina
**Jones, Richard J., M D.** Thrombosis and Embolism
**Jones, Robert Edmond.** Theatre (*in part*)
**Jones, S. Voice** (*in part*)
**Jones, Vernon S.** Laws Relating to Seamen (*in part*)
**Jones, W. Neilson.** Chimaera
**Jopson, Norman Brooke.** Old Slavonic; Polish Language, Russian Language and Literature (*in part*); Serbo-Croatian Language (*in part*); Slavonic Language; Slavs (*in part*)
**Jordan, David Starr, M.D** Agassiz, Jean Louis Rodolphe
**Joseph, Helen Haiman.** Marionettes and Puppets
**Joseph, Horace W. B.** Species (*in part*)
**Josselyn, Lloyd W.** Canoe (*in part*)
**Jourdain, Rev. Francis C. R.** Cuckoo
**Joyce, Adrian D.** Turpentine
**Joyce, Cyril Alfred.** Juvenile Delinquency (*in part*)
**Joyce, Thomas Athol.** Colombia (*in part*); Dress (*in part*); Inca; South America (*in part*); West Indies, The (*in part*)
**Judson, Lewis Van Hagen.** Measures and Weights
**Jull, Morley Allan.** Poultry and Poultry Farming; Turkey
**Jung, Frederic Theodore, M.D.** Beauty Culture
**Jutzi, W.** Dyeworks and Chemical Industries, Amalgamation of (*in part*)

**Kaempffert, Waldemar.** Inventions and Discoveries
**Kahn, Ely Jacques.** Colour in Architecture; Shop Front Design (*in part*)
**Kahn, Richard Arthur.** Physical Natural Resources (*in part*)
**Kalem, Theodore Eustace.** O'Neill, Eugene Gladstone
**Kallen, Horace Meyer.** James, William
**Kamp, Ewald A.** Bolt
**Kandel, Isaac Leon.** Classical Education (*in part*); Degree (*in part*), Education, History of (*in part*)
**Kang, Younghill.** Bed (*in part*), Dance (*in part*), Dress (*in part*), Li Po or Li Tai Po; Societies of Art (*in part*); Tonghak or Chuntokyo; Tu Fu
**Kansas, Sidney.** Deportation (*in part*)
**Karmel, Peter Henry.** South Australia (*in part*)
**Karpen, Leo.** Furniture Manufacture (*in part*)
**Karve, Dattatreya Gopal.** Bombay (*in part*), Bombay State (*in part*); Kathiawar
**Kasner, Edward.** Levi-Civita, Tullio
**Kassel, Louis S.** Catalysis (*in part*)
**Katz, Daniel.** Aesthetics, Experimental (*in part*)
**Katz, Commander Saul.** Judge-Advocate of the Fleet
**Kawin, Ethel.** Parent Education (*in part*)
**Kay, Marshall.** Ordovician System
**Keefer, Chester Scott, M.D.** Sulfonamides, The
**Keeler, William Norton.** Raisin
**Keeling, S. V.** Cartesians
**Keesing, Felix M.** Batak; Bontok; Igorot
**Keeton, George Williams.** Torture (*in part*)
**Keith, Sir Arthur, M D.** Man, Evolution of
**Keith, E. Gordon.** Corporation Tax
**Keller, Arthur Charles.** Gramophone (*in part*)
**Keller, Kaufman Thuma.** Chrysler Corporation
**Keller, Walter David.** Tripoli
**Kellett, E. E.** Jew, The Wandering (*in part*); Paston Letters ([illegible] (*in part*), Prose (*in part*); [illegible]. Round Table, Sonnet; [illegible]
**Kelley, Charles Fabens.** Bronze and Brass Ornamental Work (*in part*)
**Kelley, Florence.** Sweating System (*in part*)
**Kelley, Robert F.** Polo (*in part*)
**Kelliher, Harry P.** Trans-Oceanic and Trans-Continental Flights (*in part*)
**Kellogg, Charles E.** Glinka, Konstantin Dimitrievich
**Kellogg, Vernon.** Burbank, Luther, Hoover, Herbert Clark (*in part*)
**Kelly, George Arthur.** Pullman Incorporated (Delaware)
**Kelly, Raymond John.** American Legion
**Kelsen, Hans.** Absolutism, Political
**Kelsey, Clarence Hill.** Title Guarantee Companies
**Kelsey, Frances Oldham, M D** Atropine; Digitalis
**Keltie, Sir John Scott.** Africa (*in part*); Livingstone, David
**Kempff, Clarence Selby.** Ship Lanes of the North Atlantic (*in part*)
**Kendall, E. C.** Addison's Disease; Adrenal Glands
**Kendall, Henry M.** Air; Belle-Ile-En-Mer; Corsica (*in part*); Tahiti; Tripoli (*in part*)
**Kendrick, Albert Frank.** Dress (*in part*); Interior Decoration (*in part*); Textiles and Embroideries (*in part*)
**Kendrick, Benjamin B.** Calhoun, John Caldwell; Hayes, Rutherford Birchard (*in part*); Johnson, Andrew; Quincy, Josiah
**Kendrick, Thomas Downing.** Balearic Islands (*in part*); Corsica (*in part*), Druidism; Malta (*in part*); Sardinia (*in part*)
**Kennard, Earle Hesse.** Kinetic Theory of Matter (*in part*); Radiometer
**Kennedy, Rev. Archibald Robert Stirling, D.D.** Tabernacle
**Kennedy, Sir Charles Malcolm.** Commercial Treaties (*in part*)
**Kennedy, Clarence Hamilton.** Dragonfly; Insect (*in part*)
**Kennedy, Edward T.** Water Polo
**Kennedy, John Joseph.** Sodium (*in part*)
**Kennedy, John Lyon.** Parapsychology; Psychical Research (*in part*)
**Kennedy, Major General John Noble.** Artillery (*in part*)

**Kennedy, Vincent Lorne.** Assumption, Feast of; Exorcism
**Kenny, Meave,** M.D. Puerperal Fever
**Kent, Francis Lawrence.** Libraries (*in part*); Periodical (*in part*)
**Kenyon, Dorothy.** Husband and Wife (*in part*)
**Kerby, C. Edith.** Blindness (*in part*)
**Kern, William H.** Pigeon-Flying
**Kerr, Charles, Jr.** [illegible] (*in part*)
**Kerr, Clark.** Industrial Relations (*in part*)
**Kerr, Duncan J.** Lehigh Valley Railroad, The
**Kerr, Sir John Graham.** Vertebrate Embryology (*in part*)
**Kerr, Philip Henry, Marquess of Lothian.** Rhodes Scholarships
**Kerwin, Jerome Gregory.** Alderman; Autocracy; Democratic Party (*in part*); Filibuster
**Kester, Roy Bernard.** Cost Accounting (*in part*)
**Ketch, James Moss.** Reflectors
**Ketchum, Marshall D.** Investments: In Business; Investment Trusts; Listed Securities
**Kettering, Charles Franklin.** Motor Car (*in part*)
**Kettle, Arnold Charles.** Novel (*in part*)
**Keutgen, Friedrich Wilhelm Eduard.** Commune (*in part*)
**Key, V. O., Jr.** Corrupt Practices (*in part*); National Convention, The (*in part*); Party, Political; Referendum and Initiative; Spoils System (*in part*)
**Keyes, Henry Wilder.** New Hampshire (*in part*)
**Keynes, Geoffrey Langdon,** M.D. Blake, William
**Kiernan, Loyd J.** Railways (*in part*)
**Kilborn, Holloway.** Drop Forging (*in part*); Forging
**Kimball, Dexter Simpson.** Technical Education (*in part*)
**Kimball, Fiske.** Interior Decoration (*in part*); Modern Architecture, 18th and 19th Centuries (*in part*)
**King, Donald.** Mostaert, Jan
**King, Edward C.** Land Description (*in part*)
**King, Frank L.** Fountain Pen
**King, Hugh P.** Instalment Selling
**King, James F.** Colombia (*in part*)
**King, John.** Light (Thin) Castings Industry
**King, Willford Isbell.** Demand; Diminishing Returns; Panic (*in part*); Trade Forecasts; Trusts (*in part*)
**King, William Bernard Robinson.** Coprolites (*in part*); England (*in part*); Springs
**King-Page, Douglas.** Marine Insurance (*in part*)
**Kingsbury, Forrest Alva.** Abilities, General and Special; Psychological Tests
**Kingsford, Charles Lethbridge.** Buckingham, Henry Stafford, 2nd Duke of; Edward IV; Henry IV; Henry VI; Richard II; Richard III; Salisbury, Thomas de Montacute; Somerset, Edmund Beaufort, Duke of; Whittington, Richard
**Kingsford, H. S.** Seals (*in part*)
**Kingslake, Rudolf.** Photography (*in part*)
**Kinietz, Vernon.** Schoolcraft, Henry Rowe
**Kinkeldey, Otto.** Chinese Music
**Kinley, David.** Illinois (*in part*); Illinois, The University of (*in part*)
**Kiphuth, Robert John Herman.** Swimming (*in part*)
**Kirby, Rollin.** Cartoon (*in part*)
**Kircher, Paul.** Accrued Expenses; Accrued Income
**Kirchwey, George W.** Convict; Habitual Offenders (*in part*): House of Correction or Bridewell, Imprisonment, Penology
**Kirk, George Eden.** Aden; Arabia (*in part*); Arab League; Cyrenaica (*in part*); Ibn Sa'ud, 'Abd ul-'Aziz ibn 'Abd ur-Rahmān ibn Faisal, Kuwait (*in part*); Lebanon (*in part*); Mediterranean Sea (*in part*), Palestine (*in part*); Syria (*in part*), Transjordan (*in part*); Tripolitania (*in part*)
**Kirk, Paul L.** Ultramicrochemistry
**Kirkup, Thomas.** Julian (*in part*); Lassalle, Ferdinand
**Kirkwood, John Gamble.** Liquid State, The
**Kirsner, Joseph B.,** M.D. Liver and Gall-Bladder, Diseases of
**Kistiakowsky, George B.** Cyclonite; Detonation, Explosives, Lead Azide; Mercuric Fulminate; Nitrocellulose; Nitroglycerin; Propellants; Tetryl; T.N.T.
**Kitson, Harry Dexter.** Job Analysis
**Kitson, Michael William Lely.** Caravaggio, Michelangelo da; Vouet, Simon
**Klauder, Charles Z.** University Architecture (*in part*)
**Klein, Major Adrian B.** Colour-Music
**Klein, David Ballin.** Dreams
**Kleitman, Nathaniel.** Sleep
**Klemin, Alexander.** Gliding (*in part*)
**Kline, Hibberd Van Buren, Jr.** Gold Coast (*in part*); Kontagora (*in part*), Tripoli (*in part*)
**Kloeke, G. G.** Dutch Language (*in part*)
**Klopsteg, Paul Ernest.** Archery; Vacuum (*in part*)
**Klüver, Heinrich.** Eidetic Images
**Knapp, A. W.** Chocolate (*in part*)
**Knappett, Charles Richard,** M.D. Antiseptics (*in part*)
**Kneale, William Calvert.** Frege, Gottlob
**Knight, Frank Hyneman.** Capital and Interest; Economics; Individualism
**Knight, Grant C.** Stockton, Francis Richard
**Knight, Henry Granger.** Coco-Nut Oil and Cake, Maple Sugar, Margarine
**Knopf, Adolph.** Becke, Friedrich
**Knott, Henry William Howard.** Hughes, Charles Evans (*in part*)
**Knott, James Edward.** Lettuce
**Knowles, C. M.** Workmen's Compensation (*in part*)
**Knowles, Hugh S.** Loud-Speaker
**Knox, Major General Sir Alfred William Fortescue.** Nicholas (Grand Duke)
**Knox, Dudley Wright.** American Revolution (*in part*); War of 1812, The
**Knox, Edmund George Valpy.** Horace; Limericks; Parody
**Knox, Rev. G. W.,** D.D. Christianity (*in part*)
**Knox, Winifred F.** Saladin (*in part*)
**Knox-Shaw, Harold.** Nebula
**Knudsen, Ole Ferdinand.** Norway (*in part*)
**Kobbé, William H.** Sulphur, Special Applications of
**Koch, Helen Lois.** Child Psychology and Development; Handedness
**Koeber, R. B.** San Francisco (*in part*)
**Köhler, Wolfgang.** Psychology, History of (*in part*)
**Kohman, Truman Paul.** Radium; Radon
**Kohn, Hans.** Abyssinia (*in part*); Colour and Race (*in part*); Communism; Damascus (*in part*); Democracy (*in part*); Dobruja (*in part*); Fascism; Greece (*in part*); Haifa; Imperialism; Jerusalem (*in part*); Minorities; Mustafa Kemal Ataturk (*in part*); Nationalism (*in part*); National Socialism; Nehru, Jawaharlal (*in part*); Palestine (*in part*); Pan-Slavism; Ruthenia or Carpathian Ruthenia (*in part*); Tel Aviv (*in part*)
**Kolb, Avery E.** Motor Transport, Military
**Kolb, Lawrence,** M.D. Drug Addiction (*in part*)
**Komisarjevsky, Theodore.** Acting (*in part*)
**Konody, Paul G.** Art (*in part*); Impressionism; Post-Impressionism; Potter, Paul
**Kook, Edward.** Stage Design (*in part*)
**Kornerup, Bjørn.** Andersen, Hans Niels
**Kossoris, Max Davis.** Industrial Accidents
**Kracek, Frank Charles.** Polymorphism
**Kraehenbuehl, John Otto.** Lighting and Artificial Illumination (*in part*)
**Kramer, Victor.** Dry Cleaning; Laundry Industry
**Krause, Arlington Colton,** M.D. Spectacles
**Krause, Captain Roland Ernest.** World War II (*in part*)
**Kravis, Irving B.** Prices, Statistics of (*in part*)
**Krebs, Hans Adolf.** Citric Acid
**Kreps, Theodore J.** Trade Organization
**Kreutzberg, Harald.** Pantomime
**Krock, Arthur.** Baruch, Bernard Mannes
**Kroeber, Alfred L.** Algonkin; Athabascan; Aztec; Chinook; Cree; Creek; Dakota; Flathead; Hokan; Hopi; Iroquois; Kiowa; Kootenay; Kwakiutl; Mandan; Micmac; Muskogian Indians; North America (*in part*), North Pacific Coast Indians (*in part*), Ojibwa; Pima; Plains Indians; Powhatan, Pueblo (*in part*); Siouan Indians (*in part*), Tlingit, Uto-Aztecan Family
**Krom, Nicolaas Johannes.** Cambodia (*in part*), Java (*in part*)
**Kronfeld, Peter C.,** M.D. Colour Blindness, Trachoma
**Kropa, Edward L.** Fumaric and Maleic Acids; Plastics; Resins
**Kropotkin, Prince Peter Alexeivitch.** Anarchism (*in part*); Bulgaria, Eastern, Syr-Darya (*in part*)
**Krug, Julius A.** Government Departments (*in part*)
**Krumbacher, K.** Greek Literature (*in part*)
**Krusen, Frank Hammond,** M.D. Electrotherapy and Electrodiagnosis; Ultrasonics in Medicine
**Krutch, Joseph W.** Cabell, (James) Branch (*in part*)
**Kubie, Lawrence Schlesinger,** M.D. Psychiatry (*in part*); Psychoanalysis (*in part*)
**Kühnel, Ernst.** Persian Painting and Calligraphy (*in part*)
**Kulischer, Eugene.** Migration
**Kumler, Katherine W.** Home Sewing
**Kunz, George Frederick.** Jade and Other Hard Stone Carvings; Lapidary and Gem Cutting
**Kurn, James M.** St. Louis-San Francisco Railway Company (*in part*)
**Kurtz, Rev. Daniel Webster,** D.D. German Baptist Brethren (*in part*)
**Kuznets, Simon.** National Income; Wealth, National, Wealth and Income, Statistics of

**Laaman, Eduard.** Estonia (*in part*)
**Labadie-Eurite, Juan.** Aguadilla (*in part*); Caguas; Fajardo; Humacao (*in part*); Ponce (*in part*); Porto Rico (*in part*); San German; San Juan (*in part*)
**Labouret, Henri.** Africa (*in part*); Hausa (*in part*)
**Lacey, Thomas Alexander,** D.D. Augustine, Saint (Aurelius Augustinus); Church (*in part*)
**LaFarge, The Reverend John,** S.J. Roman Catholic Church (*in part*)
**Lagarde, Henri.** Banque de France
**Laidlay, E. C.** Fur
**Lake, Kirsopp.** Soden, Hermann von
**Lake, Philip.** Asia (*in part*), Continents, Origin of; Europe (*in part*) (*in part*); India (*in part*)
**Lallou, William J.,** S.T.D. Consecration
**Lamar, John Everts.** Cement Rock; Stone
**Lamb, Frank D.** Ore Dressing
**Lamb, M. C.** Leather
**Lamb, Walter Rangeley Maitland.** Academy, Royal (*in part*)
**Lambert, James Douglas.** Belgium (*in part*); France (*in part*); Holland (*in part*), Luxembourg; Paris (*in part*); Spain (*in part*)
**Lambert, Walter Davis.** Geodesy
**LaMont, Stewart M.** Accident Insurance, Personal (*in part*)
**Lamoureux, Andrew Jackson.** Atacama, Desert of; Belém (*in part*); Bogotá (*in part*); Venezuela (*in part*)
**Lancour, Harold.** Auctions and Auctioneers (*in part*)
**Landauer, H. Edgar.** Dyeworks and Chemical Industries, Amalgamation of (*in part*); Siemens (*in part*); Vereinigte Industrie-Unternehmungen Aktiengesellschaft
**Landells, Walter.** Jobber (London Stock Exchange); Stockbroker (*in part*)
**Lander, Cecil Howard.** Fuel: A General Survey
**Landis, Benson Y.** Anti-Semitism (*in part*)
**Landis, Carney.** Emotion; Psychogalvanic Reflex (*in part*)

**Landis, James McCauley.** Alien (*in part*); Ejectment (*in part*); Executors and Administrators (*in part*); Extradition (*in part*); Habeas Corpus (*in part*); Intestacy (*in part*); Land Titles (*in part*), Maintenance and Champerty (*in part*); Nullity of Marriage (*in part*); Partnership (*in part*); Petition of Right (*in part*); Police Power; Statute (*in part*), Summary Jurisdiction (*in part*); Sunday (*in part*); Treason (*in part*), Trust and Trustees (*in part*); Usury; Warrant (*in part*); Writ (*in part*)
**Landon, Grace J.** Lumbering (*in part*)
**Lane, Ernest Preston.** Invoice
**Lane, James W.** Fraser, James Earle
**Lane-Poole, Stanley.** Burton, Sir Richard Francis
**Lang, Andrew.** Apparitions; La Cloche, James de (*in part*); Prometheus (*in part*); Second Sight; Tale (*in part*)
**Langdon, Stephen Herbert.** Assur, Ashur, Asur; Babylonian and Assyrian Religion; Creation, Epic of; Hammurabi; Marduk; Mesopotamia (*in part*); Nebo or Nabu; Oannes; Sin, Tammuz
**Langer, Rudolph Ernest.** Birkhoff, George David (*in part*); Calculus of Differences; Differential Equations; Mensuration
**Langfeld, Herbert Sidney.** Aesthetics, Experimental (*in part*); Stumpf, Carl
**Langworthy, R. A.** Steam Accumulators
**Lansbury, John, M.D.** Gout
**Lanterman, Walter Firth.** Broadcasting (*in part*)
**Lanza, Anthony J., M.D.** Pneumonoconiosis
**Lapworth, Herbert.** Well
**Lardner, George E.** Crossword
**Larkin, Richard N.** Electricity Supply: Commercial Aspects (*in part*)
**Larking, Captain Albert.** Early Closing Movement (*in part*)
**Larmor, Sir Joseph.** Energy (*in part*)
**Larsen, Arthur J.** Minnesota (*in part*)
**Larsen, Helge.** Denmark (*in part*); Greenland
**Larson, Taft Alfred.** Wyoming
**Lashley, Karl S.** Instinct; Psychology (*in part*)
**Laski, Harold J.** Anarchism (*in part*); Bolshevism (*in part*); Laissez-Faire
**Lasky, Jesse L.** Motion Pictures (*in part*)
**Lasswell, Harold D.** Propaganda
**Latey, William.** Nullity of Marriage (*in part*); Press Laws (*in part*); Sunday (*in part*)
**Lathrop, John Howland, D.D.** Unitarianism (*in part*)
**Latimer, Wendell Mitchell.** Chromium (*in part*); Lewis, Gilbert Newton; Manganese; Oxidation and Reduction
**Latourette, Kenneth Scott, D.D.** China (*in part*); Chinese Literature; Chinese Eastern Railway, Formosa (*in part*); Manchuria (Manchoukuo) (*in part*); Missions (*in part*); Mongolia (*in part*)
**Laughton, L. G. Carr.** Ships' Figureheads
**Laurie, Arthur Pillans.** Fresco Painting
**Lautzenhiser, Fred B.** Motor Vehicles, Commercial
**Law, Edward F.** Anti-Friction Metals
**Law, K. C.** Fire Insurance
**LaWall, Charles H.** Pharmacy (*in part*)
**Lawrence, Colonel Thomas Edward.** Guerrilla Warfare (*in part*)
**Lawrence, William Henry.** Perspective
**Lawson, Major General Edward Frederick, 4th Baron Burnham.** Yeomanry (*in part*)
**Lawton, Graham Henry.** South Australia (*in part*)
**Layard, George Somes.** Keene, Charles Samuel (*in part*); Linton, William James
**Lazarus-Barlow, Percy, M.D.** Calculi or Stones (*in part*)
**Lazarus-Barlow, Walter Sydney, M.D.** Auscultation; Inflammation and Its Sequels; Mammary Gland, Diseases of; Mirror-Writing, Mouth and Salivary Glands (*in part*); Pericardium, Diseases of the; Quackery (*in part*); Sunlight Treatment (*in part*)
**Lea, C. A. E.** Gallabat
**Leach, Edmund Ronald.** Miao-Tsze
**Leacock, Stephen Butler.** Alberta (*in part*); British Columbia (*in part*); Canada (*in part*), Humour, Manitoba (*in part*), Montreal (*in part*), New Brunswick (*in part*); Northwest Territories (*in part*), Nova Scotia (*in part*), Saskatchewan (*in part*)
**Leake, James Miller.** Florida
**Leake, James P., M D** Smallpox, Vaccination
**Leathes, Sir Stanley Mordaunt.** Cromwell, Oliver
**Leavens, Dickson H.** Bimetallism (*in part*); Tael (*in part*)
**Lebesgue, Philéas.** Greek Literature (*in part*)
**Leckie, John.** Pencil Drawing (*in part*)
**Lederer, Emil.** International, The (*in part*)
**Lee, Major General Alec Wilfred.** World War II (*in part*)
**Lee, Robert Warden.** Roman-Dutch Law
**Leech, Lewis Harper.** Chicago (*in part*)
**Lee of Fareham, Arthur Hamilton Lee.** Sulgrave Manor
**Lee-Warner, Sir William.** Dalhousie, James Andrew Brown Ramsay, 1st Marquess and 10th Earl of (*in part*)
**Leffingwell, W. H.** Office Machines and Appliances (*in part*); Office Management
**Legge, James** Confucius (*in part*); Lâo-Tse (*in part*)
**Legge, Robin Humphrey.** Debussy, Claude A. (*in part*)
**Lehman, Eugene Heitler.** Camping (*in part*)
**Lehman, Herbert H.** War Relief Work
**Lehmann-Haupt, Carl F.** Urartu
**Lehmann-Haupt, Hellmut.** Bookselling (*in part*)
**Lehmer, Derrick Henry.** Bernoulli Numbers or Bernoullian Numbers
**Leigh, Richard Henry.** Uniforms (*in part*)
**Leighly, John.** Running Water; Seasons
**Leighton, Morris M.** Glacial Epoch (*in part*)
**Leiserson, William M.** Industrial Relations (*in part*)
**Leland, Simeon Elbridge.** National Debt
**Lemmer, Friedrich.** Krupp
**Lemon, Harvey Brace.** Bohr, Niels; Capacitance; Capillary Tube
**Lenoir, Robert Maurice Jean.** Watches (*in part*)
**Lenroot, Katharine Fredrica.** Child Welfare and Child Labour (*in part*), Maternal and Child Health (*in part*)
**Lentelli, Leo.** Sculpture Technique (*in part*)
**Lenti, Libero.** Italy (*in part*)
**Leopold, Aldo.** Game Management
**Lerner, Abba P.** Investments, Economic Aspects of
**Lesar, Hiram H.** Landlord and Tenant (*in part*)
**Lescohier, Don Divance.** Casual Labour (*in part*); Profit-Sharing (*in part*); Unemployment Insurance (*in part*)
**Lester, Robert MacDonald.** Carnegie Trusts (*in part*)
**Lethaby, William Richard.** Design (*in part*)
**Lethbridge, Thomas Charles.** Scandinavian Civilization (*in part*)
**Letiche, John M.** Balance of Payments
**Leveson, William Egbert.** Chang Tso-lin; Chiang Kai-shek (*in part*)
**Levett, Ada E.** Manor (*in part*)
**Levi, Nathan.** Smuts, Jan Christiaan (*in part*)
**Levin, Isaac H.** Gems, Synthetic (*in part*)
**Levine, Philip.** Blood (*in part*)
**Levinson, André.** Bakst, Léon
**Levinson, Nathan.** Motion Pictures (*in part*)
**Levinson, Sidney O., M.D.** Serum Therapy
**Levy, Oscar, M.D.** Nietzsche, Friedrich Wilhelm
**Levy, Reuben.** Ecbatana; Susa
**Lewin, Bertram David, M.D.** Psychoanalysis (*in part*)
**Lewis, Bernard.** Assassin
**Lewis, Bernard.** Flame
**Lewis, B. R.** Guerrilla Warfare (*in part*)
**Lewis, Cal.** Clothing Manufacture (*in part*)
**Lewis, Charles F.** Pittsburgh
**Lewis, Geoffrey Lewis.** Kuprili; Mahmud I; Mohammed I, II, III, IV; Murad I, II, III, IV; Selim I, Selim II; Selim III, Soliman I, II, Turkey (*in part*)
**Lewis, Henry.** Breton Literature; Cornish Language
**Lewis, M. R.** Drainage of Land (*in part*)
**Lewis, Peter Edwin.** Court (*in part*); Hanging (*in part*), Landlord and Tenant (*in part*); Legitimacy and Legitimation (*in part*); Statute (*in part*)
**Lewis, Robert Strong.** Mining, Metalliferous (*in part*)
**Lewis, Samuel Richard.** Ventilation
**Lewis, Stuart.** Assessor (*in part*); Associate Justice; Budget (*in part*), Corrupt Practices (*in part*); Initiative, Mason and Dixon Line; National Convention, The (*in part*) Township
**Lewis, William Draper.** Judicial Reform (*in part*); Marshall, John
**Lewis, W. S.** Austria (*in part*), Austria, Lower; Budapest (*in part*), Burgenland, Carinthia; Carlsbad (Bohemia) (*in part*), Carpathian Mountains; Prague, Styria; Tatra Mountains, Tirol (*in part*); Vienna (*in part*)
**Lewkowitsch, P. R. Elsa.** Almond Oil (*in part*); Beeswax (*in part*), Bone, Industrial Uses of (*in part*); Candle (*in part*), Essential Oils (*in part*); Oils, Fats and Waxes (*in part*); Palm Oil (*in part*); Tung Oil (*in part*); Whale Oil (*in part*)
**Leyser, Karl Joseph.** Germany (*in part*), Welf
**Lichtenstein, Walter.** Bank for International Settlements (*in part*)
**Liddell Hart, Captain B. H.** Allenby, Edmund Henry Hynman, 1st Viscount, Aspern-Essling, Battle of; Bretonfield, Cambrai, Battle of; Chemin-Des-Dames, Hamilton, Sir Ian Standish Monteith, Ilipa, Battle of; Mantineia; Marne, Second Battle of The; Mongol Campaigns; Pershing, John Joseph (*in part*); Quebec (*in part*), St Quentin, Battle of, 1918; Salonika Campaigns, 1915–18, Somme, Battles of The, 1916; World War I (*in part*); World War II (*in part*); Ypres, Battles of, 1917
**Liebeschütz, Hans.** Brandenburg (Margraviate)
**Liebman, A. J.** Whisky or Whiskey (*in part*)
**Liefmann, W. Robert.** Cartel or Kartel
**Liegler, L.** Vienna (*in part*)
**Lierle, D. M., M D** Deaf and Hard of Hearing, Education of (*in part*)
**Lietzmann, Hans, D.Th.** Baptism (*in part*); Creeds (*in part*)
**Lillie, Frank R.** Feather (*in part*)
**Lillie, Ralph D., M.D** Psittacosis
**Limentani, Uberto.** Italian Literature (*in part*); Novel (*in part*)
**Linck, Lawrence J.** Cripples
**Lincoln, Frederick C.** Bird banding
**Lindsay, Alexander Dunlop, 1st Baron Lindsay of Birker.** Adult Education (*in part*)
**Lindsay, Samuel McCune.** International Labour Organization, The; Liquor Laws and Liquor Control; Prohibition
**Lindsay, Rev. Thomas Martin, D.D.** Lollards (*in part*); Lutherans (*in part*); Thomas a Kempis
**Lindstrom, Ernest Walter.** Plant Breeding
**Ling, Arthur Robert.** Malt (*in part*)
**Lingane, James J.** Polarography
**Link, Arthur S.** Daniels, Josephus
**Linton, Morris Albert.** Actuary
**Linton, Robert R., M D.** Varicose Veins
**Lipman, Jacob Goodale.** Agricultural Education (*in part*)
**Lippmann, Walter.** Pulitzer, Joseph (*in part*)
**Lipsett, Caldwell H.** Afridi (*in part*)
**Lipson, Leslie.** Governor (*in part*)
**Lissens, René Felix.** Belgian Literature (*in part*)
**Little, Clarence Cook.** Cancer Research
**Little, Frances.** Textiles and Embroideries (*in part*)
**Little, Sir Rudolf Alexander.** Post and Postal Services (*in part*)
**Little, Stuart.** Match

Littlefield, Catherine. Ballet
Livermore, Harold Victor. Portugal
Livingstone, C. J. Motor Car Engines: Their Operation and Care (*in part*)
Llewellyn, Karl Nickerson. Bill of Exchange (*in part*), Chattel Mortgage; Conditional Sale (*in part*), Factor (*in part*), Foreclosure (*in part*); Guarantee (*in part*); Instalment Purchase (*in part*); Sale of Goods (*in part*); Valuation and Values (*in part*)
Lloyd, Charles Christopher, F.R.H.S. Keith, George Keith Elphinstone
Lloyd, Charles Mostyn. Pauper; Poor Law (*in part*); Workhouse
Lloyd, E. M. H. Rationing (*in part*); War Control of Food (*in part*)
Lloyd, Francis Ernest. Byblis; Carnivorous Plants; Darlingtonia; Drosophyllum; Pinguicula; Pitcher Plants, Roridula; Sundew; Utricularia; Venus's Fly-Trap
Lloyd, Sir John Edward. Wales (*in part*)
Lloyd, Nathaniel. Brickwork
Lloyd-James, Arthur. Pronunciation
Lobel, Edgar. Sappho
Lobingier, Charles Sumner. Aliaga, Antipolo; Aparri; Argao; Bacolod; Baguio, Balayan; Baliuag; Barotac Nuevo; Barugo; Batac; Batangas; Bauan; Baybay; Binan; Binmaley; Bogó; Bulacan; Burauen; Cabatuan; Cadiz; Calamba or Klamba; Calasiao; Candon; Carcar, Carigara, Hagonoy; Ilagan, Iloilo; Iriga; Manila; Philippine Islands (*in part*); San Carlos; San Fernando (de la Union); San Pablo; Santa Cruz; Surigao (*in part*); Taal, Tabaco, Tarlac; Tayabas; Tuguegarao; Zamboanga
Loch, John Eugr. Malaya (*in part*)
Locke, Alain LeRoy. Negro, The American (*in part*)
Locket, Margery. Motion Pictures (*in part*)
Lockhart, Laurence. 'Abbas I; Merv; Persia (*in part*), Riza Shah Pahlavi
Lodge, Gonzalez. Classical Education (*in part*)
Lodge, Sir Oliver Joseph. Spiritualism
Loeb, Leonard Benedict. Corkscrew; Electricity, Conduction of (*in part*)
Loeffel, William John. Bacon, Beef (*in part*); Meat (*in part*); Pork
Loewe, Herbert Martin James. Calendar (*in part*); Chronology (*in part*), Essenes; Jerusalem (*in part*); Jews (*in part*)
Loewenfeld, Erwin Hugo. Arbitration (*in part*)
Loewenson, Leo. Osterman, Andrei Ivanovich
Loewenstein, Karl. German Law (*in part*)
Loewy, Raymond Fernand. Motor Car (*in part*)
Lohr, Lenox Riley. Exhibitions and Fairs (*in part*); Museums and Art Galleries (*in part*)
Lokey, Eugene. Stock Exchange or Bourse (*in part*)
Lomax, John Avery. Folk-Song (*in part*)
Lomax, Paul S. Commercial Education (*in part*)
Lombardini, M. S. Pirelli, Ltd (*in part*)
Lones, Thomas East. Meters, Electric
Long, Edward Ernest. Amboina (*in part*); Bachian (*in part*); Bali (*in part*); Bandung (*in part*); Banka (*in part*); Bantam; Batavia (*in part*), Celebes; Ceram (*in part*); Flores (*in part*); Garut (*in part*), Jambi (*in part*); Jokjakarta or Jokyakarta; Ke Islands, Lampongs (The) (*in part*); Lambok; Macassar (*in part*); Madura; Malay Archipelago (*in part*); Mentawei; New Guinea (*in part*), Nias, Palembang (*in part*), Sangihe (Sangir) and Talaut Islands (*in part*); Semarang (Residency) (*in part*); Semarang (Town) (*in part*), Solor and Alor Islands (*in part*), Sula Islands (*in part*); Sumatra (*in part*); Sumba (*in part*); Sumbawa (*in part*); Surabaya (Port) (*in part*); Surakarta (*in part*), Ternate (*in part*), Tidore or Tidor (*in part*); Timor; Timor Laut, Tenimbar or Tenimber (*in part*)
Long, Esmond Ray, M D Tuberculosis
Long, H. C. Great Britain (*in part*)
Long, Richard C. E. Calendar (*in part*), Chronology (*in part*)
Long, Robert A. Lumbering (*in part*)
Longford, Edward Arthur Henry Pakenham, Earl of. Irish Literature (*in part*)
Longhurst, Margaret Helen. Effigies, Monumental, Ivory Carving (*in part*)
Longhurst, Percy. Wrestling (*in part*)
Longley, William Raymond. Descriptive Geometry
Longmuir, Percy. Founding, Needle
Longnon, Auguste. Champagne (*in part*)
Loomis, C. Frances. Girls, Camp Fire
Lord, Isabel Ely. Home Economics, Oriental Cookery; Preserving and Bottling (*in part*)
Lorimer, Lieutenant Colonel David Lockhart Robertson. Buriushaski Language
Lorwin, Lewis L. Direct Action
Lothrop, Samuel Kirkland. Alacaluf; Ona; Pipil; Pokomam, Quiché, Yahgan
Lotka, Alfred J. Birth-Rate (*in part*); Death-Rate (*in part*); Longevity (*in part*); Marriage-Rate; Sex Ratio (*in part*)
Lott, Arnold S. Aircraft Carrier; Destroyer; Dockyards and Naval Bases (*in part*); Mines (Naval); Monitor, Naval; Submarine Campaigns (World Wars I and II) (*in part*); Torpedoes, Torpedoplane
Loughran, Charles Patrick, S J Montanism
Louis, Henry. Blowing Engines
Lovejoy, Ellis. Brick (*in part*)
Loveland, Edward Rutherford. American College of Physicians
Lowell, A. Lawrence. Lowell Institute
Lowes, John Livingston. Lowell, Amy
Lowie, Robert Harry. Relationship Terms; Sororate
Lubker, Robert A. Invar
Lucas, Anthony Thomas. Ireland (*in part*)
Lucas, Cyril Edward. Plankton
Lucas, Edward Verrall. Austen, Jane; Lamb, Charles (*in part*)
Lucas, Jo Desha. Women, Legal Position of (*in part*), Women's Suffrage (*in part*)
Luce, Alexander W. Voting Machines
Luce, J. W. Gin (*in part*)
Luchaire, Achille. Papacy (*in part*)
Luchaire, Julien. Intellectual Co-operation, International Institute of (*in part*)
Luckhardt, Arno B. Bayliss, Sir William Maddock; Bell, Sir Charles; Cannon, Walter Bradford; Ethyl Chloride (*in part*); Ethylene (*in part*)
Luckock, Major General Russell Mortimer. Amiens, Battle of (1918)
Ludwig, Emil. Hohenzollern Dynasty
Lugard, Frederick Dealtry Lugard, 1st Baron. Mandate (*in part*); Slavery (*in part*)
Lugard, Lady (Flora). Nigeria (*in part*); Rhodes, Cecil John (*in part*)
Lumsden, E. S. Etching (*in part*)
Lundell, R. A. Pneumatic Tools
Lundy, John Silas, M.D. Anaesthesia and Anaesthetics
Lush, Jay Laurence. Animal Breeding; Animals, Domestication of; Breeds and Breeding; Inbreeding
Lutyens, Edith. Costume Design, Theatrical (*in part*)
Lutz, Friedrich A. Monetary Agreement
Lützow, Count. Hussites
Lyall, Sir Charles James. Arabic Literature (*in part*); Hamasa (*in part*); Hindōstānī Literature; Mofaḍḍalīyāt; Tulsī Dās (*in part*)
Lybyer, Albert Howe. Turkey (*in part*)
Lydekker, Richard. Sheep (*in part*)
Lyell, Colonel David. Light Railways, Military (*in part*)
Lynch, Daniel F. J. Cottonseed (*in part*)
Lynch, Patrick K. Ireland, Republic of (*in part*)
Lynd, Robert. Bennett, Enoch Arnold
Lynip, B. F., Jr. Sugar (*in part*)
Lyon, Harold Lloyd. Sugar (*in part*)

Mabbott, John David. Free Will
Macalister, Alexander, M.D. Palmistry
Macalister, Robert Alexander Stewart. Cú Chulainn; Deirdre; Diptych; Edom (*in part*), Finn Mac Cumhaill; Ireland (*in part*); Oisin; Palestine (*in part*)
McAllister, Elizabeth Glen. Housing (*in part*)
McAllister, Gilbert. Housing (*in part*)
Macartney, Carlile Aylmer. Alexandrov, Todor, Aquileia, Asen or Assen, Austria, Empire of (*in part*); Avars, Bulgaria (*in part*); Conrad von Hotzendorf, Franz, Cumans or Comans, Czech, Francis Joseph I, Galicia (*in part*), Goebbels, Josef; Goluchowski; Habsburg or Hapsburg; Horea, Nicolas Ursu (*in part*); Hungary (*in part*); Kun, Bela; Ludendorff, Erich (*in part*), Military Frontier; Petchenegs or Patzinaks; Rudolph of Habsburg; Ruthenians; Schnitzler, Arthur; Silesia; Slovakia; Successor State; Transylvania (*in part*); Trnovo
Macartney, Sir Mervyn E. London (*in part*)
Macaulay, George Campbell. Gower, John
Macaulay, Thomas Babington, 1st Baron Macaulay of Rothley. Bunyan, John; Goldsmith, Oliver; Johnson, Samuel (*in part*)
Macaulay, William Herrick. Motion, Laws of (*in part*)
McBain, James William. Detergents and Wetting Agents
MacBride, Ernest William. Metamorphosis (*in part*); Phoronidea (*in part*)
McBride, George McCutchen. Bolivia (*in part*), Cuba (*in part*); Florianopolis (*in part*); La Paz (*in part*), Oruro, Venezuela (*in part*); West Indies, The (*in part*)
McBryde, F. Webster. Central America (*in part*)
McCall, John Oppie, D.D S. Pyorrhoea (*in part*)
McCallien, William John. Gold Coast (*in part*)
McCallum, Ronald Buchanan. Paris, Conference of (*in part*)
McCann, William S., M D Whipple, George Hoyt
McCartan, Edward. Sculpture (*in part*)
McCartney, James Elvins, M.D. Carriers
McClellan, Walter S., M.D. Mineral Waters (*in part*)
McClelland, Nancy Vincent. Interior Decoration (*in part*)
McCloy, John Jay. World War II (*in part*)
McClure, Sir William Kidston. Asiago, Battle of, 1916; Cadorna, Luigi; Caporetto, Battle of; Italo-Turkish War; Vittorio Veneto, Battle of
McCollum, Elmer Verner. Cereals (*in part*)
McConnell, Beatrice. Child Welfare and Child Labour (*in part*)
McConnell, F. B. Sears, Roebuck and Co.
McConnell, Francis John, D.D. Asbury, Francis
MacCormac, Henry, M D Urticaria
McCormick, Richard P. Rutgers University
McCown, Donald E. Persia (*in part*)
McCoy, Byron Omar. Dams (*in part*)
McCullough, Norman B., M D. Typhoid and Paratyphoid Fevers
McCune, Shannon. Korea (*in part*)
McCutcheon, Thomas Potter. Cobalt
McDaniel, J. S. Rope and Ropemaking (*in part*)
McDonald, Angus D. Southern Pacific Company
MacDonald, Charles B. Companies
MacDonald, Duncan B. Imām; Islamic Institutions; Sheba; Thousand and One Nights
MacDonald, Sir George. Britain (*in part*); Caledonia (*in part*); Gaul (*in part*)
Macdonald, Hugh. English Literature (*in part*)
McDonald, James Grover. Refugees and the Exchange of Populations (*in part*)
McDonald, Rt. Hon. James Ramsay. London Naval Conference, 1930, The (*in part*)
MacDonald, J. H. Budget, Business (*in part*)
MacDonald, Sir Murdoch. Irrigation (*in part*)
MacDonald, Robert, Jr. Corundum, Artificial
MacDonald, Thomas Harris. Highways, U.S.; Roads and Streets (*in part*)
MacDonell, Arthur Anthony. Kālidāsa

**Macdonell, Sir John.** Protectorate, Sovereignty (*in part*)
**Macdonogh, Michael.** Reporting (*in part*)
**MacDougald, Duncan, Jr.** Irregulars
**MacDougall, Samuel Michael.** Lotto (*in part*)
**McDougall, William.** Trance
**McDowell, D. Clay.** Surge
**MacDuffee, C. C.** Arithmetic; Coefficient; Complex Numbers, Matrices, Root
**McEachron, Karl Boyer.** Lightning and Lightning Protection (*in part*)
**McFadyean, Sir Andrew.** Inter-Ally Council of War Purchases and Finance (*in part*); Liberal Party (*in part*)
**Macfadyen, Rev. Dugald.** Concordance (*in part*), Excommunication (*in part*), Glasites
**McGiffert, Arthur Cushman, D D.** Church History (*in part*)
**MacGillivray, James Robertson.** Canadian Literature (English)
**McGilvray, Charles Duncan, M D V, D.V Sc.** Glanders
**McGovern, John T.** Track and Field Sports
**McGovern, William M.** Japan (*in part*)
**Macgowan, Kenneth.** Theatre (*in part*)
**McGregor, J. E. M.** Pneumatic Dispatch
**McGregor, James Howard.** Gorilla (*in part*); Primates (*in part*)
**McGregor, Stuart.** Texas
**McGuffie, Kenneth Cunningham.** Laws Relating to Seamen (*in part*)
**McGuire, Constantine Edward.** Antofagasta; Anzoátegui; Apure (state); Aragua; Araucania; Avellaneda; Bahía Blanca, Barcelona; Barquisimeto, Bío Bío (province), Bolívar; Caldera; Cárdenas; Catamarca (province) (*in part*); Catamarca (city); Chaco; Chubut, Ciudad Bolívar; Colón; Colorado River, Córdoba; Coro; Cuba (*in part*); Cumaná; Entre Ríos (*in part*); Falcón; Formosa (*in part*); Gibara, Guadalquivir, Guanabacoa; Guanajay, Guantánamo, Haiti (*in part*); Havana (*in part*); Holguín; Jujuy (*in part*); La Guaira; La Plata; Lara, Maracaibo, Matanzas; Pampa, La, Paraguaná; Patagonia (*in part*); Port au Prince; Puerto Cabello, Puerto la Cruz, Sancti Spiritus; Santo Domingo (*in part*); Venezuela (*in part*)
**McGuire, Martin Rawson Patrick.** Clementine Literature
**McIlwaine, Henry Read.** Smith, John
**McIlwraith, Thomas Forsyth.** Canada (*in part*)
**Macintire, Horace James.** Refrigeration and Its Application (*in part*)
**Macintosh, E. R.** Omdurman
**Mackaye, Benton.** Regional Planning (*in part*)
**McKellar, Andrew.** Comets (*in part*)
**McKelvey, V. E.** Mineral Phosphates
**McKenzie, Robert Tait, M.D.** Gymnastics and Gymnasium (*in part*)
**MacKenzie, Roderick.** Greek Language (*in part*); Lettish Language, Lithuanian Language
**McKerrow, Ronald Brunlees.** Parnassus Plays
**McKhann, Charles F., M.D.** Measles and German Measles
**Mackinder, Rt. Hon. Sir Halford John.** Trade Routes (*in part*)
**McKinley, Samuel Justus.** Boston (Mass.) (*in part*)
**MacKinnon, James, D D.** Covenanters; Luther, Martin
**Mackinnon, Kenneth Wulsten.** Company and Corporation Law (*in part*)
**Mackintosh, Rev. Robert, D.D.** Dogma, Dogmatic Theory
**Maclagan, Sir Edward Douglas.** Punjab (*in part*)
**McLaughlin, Dean Benjamin.** Nova and Supernova
**Maclean, Fitzroy.** Guerrilla Warfare (*in part*)
**McLean, Neil Hartley.** Broken Hill Proprietary Company Limited
**M'Lean, Norman.** Syriac Literature
**McLeod, James Walter.** Diphtheria
**MacLeod, John J. R.** Insulin (*in part*)
**McMahon, Francis Elmer.** De Valera, Eamon (*in part*)
**MacMillan, David.** Corrugated Iron
**McMillan, Walter George** Graphite (*in part*)
**MacMunn, Lieutenant General Sir George Fletcher.** Bamian, India (*in part*), Indian Mutiny, The
**McMurtrey, James Edward, Jr.** Tobacco
**McMurtrie, Douglas C.** Books (*in part*), Collotype; De Vinne, Theodore Low
**MacNair, Harley F.** Chinese Immigration; Far Eastern Problem, The
**McNamara, Edward Joseph.** Shorthand
**McNamee, Colonel Frank A., Jr.** Observer Corps in Air Defense (*in part*)
**MacNeill, John Eoin.** Ireland (*in part*)
**McNickle, D'Arcy.** Indian, North American
**McNish, A. G.** Magnetometer, Terrestrial Magnetism
**MacPherson, John, M.D.** Paranoia
**McQuarrie, Irvine, M D** Children, Diseases of, Epilepsy and Epileptic Fit
**McQueen, Alexander.** Buncombe; Crank (*in part*), Dictionary; Slang (*in part*); Yankee
**Macurdy, L. B.** Balance
**McWhirter, Norris Dewar.** Athletic Sports (*in part*)
**Madden, J. F.** Darfur (*in part*)
**Madden, John Thomas.** Accountancy and Accountants (*in part*), Fiduciary Accounting
**Madelin, Emile Marie Louis.** Foch, Ferdinand
**Magath, Thomas Byrd, M D** Albuminuria
**Magness, John Robert.** Crab-Apple; Pear
**Magoun, Horace Winchell.** Brain (*in part*)
**Maguire, John MacArthur.** Evidence (*in part*)
**Maguire, Mary Hume.** Leach, Abby
**Mahoney, Francis B.** Micronesia
**Mair, Alexander W.** Classics; Epicurus, Livy; Lucan (Marcus Annaeus Lucanus); Lucian; Lucretius, Martial (Marcus Valerius Martialis), Menander; Petronius, Pliny The Elder, Pliny The Younger, Polybius; Seneca, Annaeus (*in part*); Seneca, Lucius Annaeus; Terence, Varro, Marcus Terentius
**Maitland, Frederic William.** Bracton, Henry De, English Law (*in part*)
**Major, Rev. Henry Dewsbury Alves, D.D.** Modernism
**Major, Ralph Hermon, M D** Diagnosis
**Malcolm, Major General Sir Neill.** Wilson, Sir Henry Hughes
**Malcolm-Smith, Elizabeth F.** Canning, Charles John; Canning, George (*in part*); Dilke, Sir Charles Wentworth
**Malinowski, Bronislaw.** Marriage
**Mallalieu, Wilbur E.** Salvage Corps (*in part*)
**Mallet, Sir Charles Edward.** Gladstone, William Ewart
**Mallon, James Joseph.** Social Settlements (*in part*), Toynbee Hall
**Man, David Morrice.** Governor (*in part*)
**Mangels, Max Cornils.** Kiel Canal (*in part*)
**Mangelsdorf, Paul Christoph.** Maize (*in part*)
**Mangin, Charles Marie Emmanuel.** Champagne, Battles in (*in part*)
**Manley, John H.** Atomic Energy
**Mann, Frank Charles, M D.** Gall-Bladder
**Mann, Frederick Justin.** Consul (*in part*)
**Mann, Stuart Edward.** Gypsies (*in part*)
**Mann, William M.** Zoological Gardens
**Mannheim, Hermann.** Crime (*in part*)
**Manning, Helen Taft.** Taft, Helen Herron
**Manning, S. C., Jr.** Shipping: War Losses of (World Wars I and II) (*in part*); Shipping: Wreck Statistics; Shipping Lines and Groups (*in part*)
**Manning, Rt. Rev. William Thomas, D.D.** Protestant Episcopal Church (*in part*)
**Manross, William W.** Protestant Episcopal Church (*in part*)
**Mansergh, (Philip) Nicholas Seton.** British Commonwealth (*in part*)
**Manship, Paul.** Sculpture (*in part*)
**Manson, James Alexander.** Bowls (*in part*)
**Manson, J. Leask.** Building (*in part*); Foundations (*in part*), Structural Engineering (*in part*)
**Manson-Bahr, Sir Philip Henry, M D.** Diarrhoea, Dysentery
**Marcel, Gabriel.** Bernard, Jean-Jacques; Romains, Jules (*in part*)
**March, Benjamin.** Iron in Art (*in part*)
**Marcus, Jacob Rader.** Jews (*in part*)
**Marcus, Ralph.** Scribes
**Marett, Robert Ranulph.** Animatism; Animism, Anthropology, Dynamism; Law (Primitive); Mana, Prayer, Religion (*in part*); Spell, Supernaturalism
**Margenau, Henry.** Energy (*in part*)
**Margetts, Arthur Richard.** Fisheries (*in part*)
**Margoliouth, David Samuel.** Egypt (*in part*); Ethiopic Literature (*in part*); Fatimites, (Fatimides) (*in part*), Mohammed (*in part*)
**Markby, Sir William.** Indian Law (*in part*)
**Markland, Ben.** Dog (*in part*)
**Marks, Lionel Simeon.** Mechanical Engineer, Power (*in part*)
**Marlow, Joseph W.** Antioquia; Baker Island, Barranquilla; Bluefields; Bogotá (*in part*); Bolívar, Bolivia (*in part*), Canton Island, Cochabamba (department), Cochabamba (city); Colombia (*in part*); Córdoba (department), Costa Rica (*in part*); Formosa (*in part*); Galápagos Islands (*in part*); Guatemala (*in part*); Guatemala (Nueva Guatemala) (*in part*); Guayaquil; Haiti (*in part*), Howland Island, Ibarra; Jarvis Island; Johnston Island, Midway Islands; Sucre; Tampico, Tehuantepec; Visit and Search (*in part*); Wake Island
**Marquis, J. Clyde.** International Institute of Agriculture
**Marr, Louis F.** Detroit
**Marrack, John Richardson, M D** Immunity (*in part*)
**Marriage, E. Charles D.** Nevada (*in part*)
**Marriott, Charles.** Religious and Memorial Architecture (*in part*)
**Marriott, Sir John Arthur Ransome.** Baldwin, Stanley Baldwin (*in part*)
**Marsh, Dorothy B.** Cakes and Cake-Making
**Marsh, Sir Edward Howard.** Brooke, Rupert
**Marsh, Rev. Fred Shipley.** Elijah, Elisha
**Marsh, Norman Stayner.** English Law (*in part*)
**Marshall, Francis Hugh Adam.** Reproduction (*in part*)
**Marshall, Frederick Henry.** Greek Language (*in part*), Greek Literature (*in part*)
**Marshall, General of the Army George Catlett.** World War II (*in part*)
**Marshall, Walter P.** Telegraph
**Marston, Philip M.** New Hampshire (*in part*)
**Marston, William Moulton.** Anger; Antipathy; Synapse (*in part*)
**Martet, Jean.** Clemenceau, Georges
**Marti, L. R.** North Dakota
**Martin, Anne Henrietta.** Butler, Josephine Elizabeth; White-Slave Traffic
**Martin, Ethel Austin.** Ice Cream (*in part*)
**Martin, G.** Rubber: Botany, Cultivation and Chemistry
**Martin, John Holmes.** Buckwheat; Millet; Sorghum; Wheat (*in part*)
**Martin, Percy A.** Brazil (*in part*)
**Martin, Robert E.** Negro, The American (*in part*)
**Martin, Thomas Powderly.** Austin, Stephen Fuller; Dallas, George Mifflin; Green, Duff; McDuffie, George
**Marts, M. E.** Cascade Mountains
**Marvin, Edwin Lakenan.** Division (*in part*)
**Marwick, Brian Allan.** Swazi; Swaziland
**Marx, Fritz Morstein.** Budget (*in part*)
**Marzials, Sir Frank Thomas.** Dumas, Alexandre; Zola, Émile Édouard Charles Antoine
**Masaryk, Tomas Garrigue.** Czechoslovakia (*in part*)
**Mason, J. Alden.** Mataco
**Massey, Charles Dudley.** Book Collecting (*in part*); Bookselling (*in part*)
**Massey, George Bragg.** Excavation

**Massey, Louis Melville.** Smut and Bunt
**Massey, Raymond.** Acting (*in part*); Motion Pictures (*in part*)
**Masson, Charles.** Portrait Painting (*in part*)
**Masson, David.** Milton, John (*in part*)
**Masterman, E. W. G.** Sepulchre, The Holy
**Matchett, Gerald J.** Wages (*in part*)
**Matheson, Colin.** Wales (*in part*)
**Mathews, Oscar Roland.** Dry Farming (*in part*)
**Matthew, William Diller.** Carnivora (*in part*); Creodonta (*in part*); Daviden; Clamtodon; Machairodus (*in part*); Mylodon (*in part*); Phenacodus, Tylopoda (*in part*)
**Matthews, Allan F.** Physical Natural Resources (*in part*)
**Matthews, D. J.** English Channel
**Matthews, F. E.** Gold (*in part*); Iridium; Osmium; Palladium; Platinum; Platinum Metals, Rhodium; Silver
**Matthews, Very Rev. Walter Robert, D.D.** Theism
**Maude, Colonel Frederic Natusch.** Franco-German War (*in part*); Napoleonic Campaigns (*in part*); Seven Years' War (*in part*); Wörth
**Maule, Harry E.** Lewis, Sinclair (*in part*)
**Maunsell, Lieutenant Colonel Francis Richard.** Diarbekr (*in part*)
**Maurer, Robert J.** Photoelectricity
**Maurice, Arthur Bartlett.** Caricature (*in part*)
**Maurice, Major General Sir Frederick Barton.** Haig, Douglas Haig; Jackson, Thomas Jonathan; Lee, Robert Edward
**Maurice, Henry Gascoyen.** Fisheries (*in part*)
**Mavris, N. G.** Dodecanese
**Mawer, Sir Allen.** Aethelflaed or Ethelfleda; Aethelstan, Danelagh (*in part*); Edred; Edward, "The Elder"; Place-Names (*in part*)
**Mawson, Thomas H.** Landscape Architecture (*in part*)
**Maxcy, Kenneth Fuller,** M.D. Epidemiology; Rocky Mountain Spotted Fever and Other Spotted Fevers; Typhus Fever
**Maxton, John P.** Agricultural Labourer (*in part*)
**Maxwell, James Clerk.** Faraday, Michael (*in part*)
**Maxwell, William Henry.** Destructors
**Maxwell, (Mrs.) Winifred Alice.** Orange Free State (*in part*); Zululand
**May, William Edward.** Compass (*in part*)
**Mayall, Nicholas Ulrich.** Nebula; Photography, Celestial (*in part*)
**Mayo, Frank Rea.** Polymerization
**Mayor, Alpheus Hyatt.** Bibiena (Bibbiena), Galli da (*in part*)
**Meakin, Budgett.** Almohades (*in part*); Almoravides (*in part*); Morocco (*in part*)
**Meakins, Jonathan Campbell,** M.D. Medicine
**Means, Lynn Lester.** Thunderstorms (*in part*)
**Mechlin, Leila.** Societies of Art (*in part*)
**Meeks, Carroll Louis Vanderslice.** Industrial Architecture; Stadium
**Mees, Charles Edward Kenneth.** Motion Pictures (*in part*), Photography (*in part*)
**Megarry, Robert Edgar.** Customary Freehold; Landlord and Tenant (*in part*); Land Tenure; Economic and Agrarian Aspects (*in part*); Laws of Real Property and Conveyancing (*in part*)
**Meggers, William Frederick.** Spectroscopy; Stark Effect, Zeeman Effect
**Mégroz, Rodolphe Louis.** Silhouette
**Mehigan, Patrick Denis.** Hurling
**Meiklejohn, Andrew,** M.D. Dangerous Trades; Industrial Medicine (*in part*)
**Meillet, Antoine.** Albanian Language; Armenian Language
**Meinel, A. B.** Telescope (*in part*)
**Meinzer, Oscar Edward.** Ground Water; Hydrology
**Melcher, Norwood B.** Nickel-Chromium Steels; Nickel Steel. Open-Hearth Steel Process; Stainless Steel
**Mellone, Sydney Herbert.** Anthropomorphism; Basilides; Bible, English (*in part*); Christianity (*in part*); Gnosticism; Heresy; Ophites; Pelagius (*in part*); Tithes; Unitarianism (*in part*)
**Mellor, Arthur.** Silk Manufacture (*in part*)
**Meloche, Villiers Willson.** Selenium; Tellurium
**Melrose, Paul C.** Hainan; Hakkas
**Mencken, Henry Louis.** Americanism; Slang (*in part*)
**Menczer, Béla.** Hungarian Literature
**Mendershausen, Horst.** Industry and Trade, War Control of (*in part*)
**Menke, Frank Grant.** Cock-Fighting or Cocking
**Menzel, D. H.** Eclipse (*in part*)
**Menzies, Rev. Allan,** D.D. Scotland, Church of (*in part*)
**Merker, Herman.** Containers, Metallic
**Merkle, F. G.** Physical Natural Resources (*in part*)
**Merrick, Frank Anderson.** Westinghouse Electric and Manufacturing Company (*in part*)
**Merrill, Elmer Drew.** Aceraceae, Bignoniaceae; Combretaceae; Cornaceae; Dipterocarpaceae; Erythroxylaceae; Gesneriaceae; Loganiaceae; Meliaceae; Philadelphus; Piperaceae; Rhamnaceae; Salicaceae; Taxaceae; Thymeleaceae; Zygophyllaceae
**Merrill, Hon. Frederick James Hamilton.** Quarrying
**Merrill, Harrison J.** Range Finders (*in part*)
**Meston, James Scorgie Meston, 1st Baron.** Egypt (*in part*); India (*in part*); Untouchables (*in part*)
**Metcalf, Zeno P.** Cicada; Cuckoo-Spit; Lantern Fly
**Metz, C. W.** Cytology; Nucleus
**Meyendorff, Baron Alexander.** Siberia (*in part*)
**Meyer, Adolf.** Insanity (*in part*)
**Meyer, A. W.** Gutta Percha (*in part*)
**Meyer, Bernard Sandler.** Plants and Plant Science (*in part*)
**Meyer, Eduard.** Ardashir; Artabanus; Artaxerxes; Astyages; Bactria; Darius; Demetrius (King of Bactria); Diodotus; Eucratides; Euthydemus; Hormizd or Hormizdas; Kavadh; Media; Mithradates (*in part*); Osroene or Osrhoene; Pacorus; Parthia; Pērōz; Persia (*in part*); Persis (*in part*); Pharnabazus; Phraates; Phraortes; Satrap; Shapur; Smerdis; Tiridates; Tissaphernes; Vologaeses; Vonones; Xerxes; Yazdegerd
**Meyer, Jacob Conrad.** Alsace-Lorraine (*in part*)
**Meyerson, Emile.** Explanation
**Meynell, Alice.** Browning, Elizabeth Barrett
**Meynell, Sir Francis.** Books (*in part*)
**Meynell, Wilfrid.** Meynell, Alice
**Mezger, Ernest.** Arbitration (*in part*)
**Michael, Max A.** Cruiser
**Michaelis, Leonor.** Free Radicals (*in part*)
**Michal, Aristotle Demetrius.** Differential Forms (*in part*); Tensor Analysis (*in part*)
**Michalak, Joseph M.** Electricity Supply: Commercial Aspects (*in part*)
**Michelson, A. A.** Interferometer (*in part*); Velocity of Light (*in part*)
**Middleton, John Henry.** Monreale (*in part*); Raphael Sanzio (*in part*), Ring (*in part*); Verona (*in part*); Wren, Sir Christopher
**Middleton, William E. Knowles.** Anemometry (*in part*); Beaufort Scale; Cloud (*in part*); Radiosonde; Upper Air Soundings; Visibility
**Miers, Sir Henry Alexander.** Diamond
**Migrdichian, Vartkes.** Cyanamide; Prussic Acid
**Mijatovich, Chedomille.** Karajich, Vuk Setfanovich (*in part*)
**Milbourne, R. J.** Gasholders
**Miles, J. Hamish.** Beerbohm, Sir Max (*in part*), Doughty, Charles Montagu
**Mill, Courtenay J.** Stock Exchange or Bourse (*in part*)
**Mill, Hugh Robert.** Geography
**Miller, Albert R.,** D.V.M. Slaughterhouse
**Miller, Lieutenant Colonel Edward Darley.** Polo (*in part*)
**Miller, Fred J.** Scientific Management (*in part*)
**Miller, George Charles.** Lithography (*in part*)
**Miller, James Grier,** M.D. Unconscious
**Miller, John A.** Electric Traction; Tramway (*in part*)
**Miller, Max C.** Hosiery; Knitting
**Miller, Philip L.** Gramophone (*in part*)
**Miller, Raymond Joseph.** Liguori, Alfonso Maria dei
**Miller, S. N.** Eburācum
**Miller, William.** Adriatic Sea (*in part*); Crete (*in part*); Fiume (*in part*); Greece (*in part*); Ionian Islands (*in part*), Skanderbeg or George Castriota; Thrace; Zaïmis, Alexander
**Miller, William.** Publishing (*in part*)
**Millett, Fred B.** Diagnosis
**Milligan, Rev. George,** D.D. James (*in part*)
**Millingen, Alexander Van,** D.D. Constantinople (*in part*)
**Millis, John Schoff.** Western Reserve University (*in part*)
**Mills, James Philip.** Assam; Chakma; Magh Mikir
**Mills, Mabel H.** Exchequer (*in part*)
**Mills, William H.** Stereochemistry (*in part*)
**Milne, Sir David.** Scotland (*in part*)
**Milne, Edward A.** Chromosphere (*in part*)
**Milne, James Malcolm.** Legal Education (*in part*)
**Milyukov, Paul.** Duma; Russia (*in part*)
**Minio-Paluello, Lorenzo.** Buridan, Jean
**Minns, Sir Ellis Hovell.** Europe (*in part*); Tauri
**Minorsky, Vladimir F.** Iranian Languages and Persian; Persian Literature
**Minser, Edward John.** Contact Weather; Ice on Aircraft; Instrument Weather; St. Elmo's Fire
**Mints, Lloyd W.** Currency
**Mirbt, Carl Theodor,** D.Th. Pius IX (*in part*); Trent, Council of (*in part*); Ultramontanism (*in part*); Vatican Council, The (*in part*)
**Mirsky, Prince Dimitri.** Chekhov, Anton Pavlovich; Dostoievski, Theodore (Fyodor) Mikhaylovich; Gorky, Maxim; Russian Language and Literature (*in part*); Tolstoy, Leo (Lyev) Nikolayevich, Count; Turgenev, Ivan Sergeyevich; Ukrainian Literature
**Mises, Ludwig von.** Boehm Von Bawerk, Eugen; Wieser, Friedrich von
**Mitchell, A. D.** Hydrogen; Indicators; Oxide (*in part*); Zinc (*in part*)
**Mitchell, J. G.** Perylene
**Mitchell, John F.** Boston (*in part*)
**Mitchell, John Malcolm.** Bacon, Francis (*in part*); Carnegie Trusts (*in part*); Harem (*in part*); Mnemonics; Neoplatonism (*in part*); Solon (*in part*); Sphinx (*in part*)
**Mitchell, Matthew Cargill.** Rhode Island
**Mitchell, Sir Peter Chalmers.** Alimentary Canal (*in part*); Biogenesis
**Mitchell, Brigadier General W. A.** Bridging, Military (*in part*)
**Mitra, Sir Dhiren.** Arbitration (*in part*)
**Mitrany, D.** Peasant Movement
**Moehlman, Conrad Henry.** Baptists
**Moelwyn-Hughes, Emyr Alun.** Chemistry (*in part*)
**Moffatt, Rev. James,** D.D. John, The Epistles of; Pastoral Epistles, The; Philemon, Epistle to; Philippians, Epistle to the, Romans, Epistle to the; Timothy or Timotheus; Titus
**Moffatt, L. E.** Household Appliances (*in part*)
**Moffett, John Perry.** Tanganyika (territory) (*in part*); Tanganyika, Lake
**Mollat, Michel.** Normandy; St. Pol, Counts of
**Momigliano, Arnaldo Dante.** Hypereides
**Momtchiloff, Nicholas Ivan.** Boris III; Bulgaria (*in part*); Exports; Stambulov, Stefan
**Money, Sir Leo Chiozza.** Armstrong (Sir W. C.), Whitworth and Co., Ltd. (*in part*); Bolckow, Vaughan & Co. Ltd.; Consolidated Gold Fields of South Africa, Ltd. (*in part*); Fine Cotton Spinners' and Doublers' Association, Ltd.; Furness, Withy and Company

Limited; Gas Light and Coke Company (*in part*); Imperial Tobacco Company, Limited, Lever Brothers & Unilever Limited (*in part*); Lloyds Bank Limited (*in part*); Marconi's Wireless Telegraph Co., Ltd; Midland Bank Limited (*in part*); Pearl (*in part*); Plaster-Work (*in part*); South Metropolitan Gas Company, Swan, Hunter, and Wigham Richardson, Ltd (*in part*); Vickers Limited (*in part*); Wall Paper Manufacturers Ltd; White Star Line (*in part*); Yorkshire Electric Power Company (*in part*)

**Monkhouse, William Cosmo.** Hunt, William Holman (*in part*); Leighton, Frederick Leighton, Baron; Millias, Sir John Everett (*in part*)

**Montague, Laurence.** Football (*in part*)

**Montgomery, Raymond Braislin.** Ekman, Vagn Walfrid; Turbulence, Atmospheric

**Moon, Parry.** Candlepower; Photometry (*in part*)

**Moore, Carl Richard.** Reproduction (*in part*)

**Moore, Coyle E.** Charity (*in part*)

**Moore, Harold.** Microscopy (*in part*)

**Moore, John Percy.** Annelida (*in part*); Leech

**Moore, Joseph Earle, M.D.** Venereal Diseases (*in part*)

**Moore, Robert Foster.** Ophthalmology

**Morehead, Max L.** Guatemala (*in part*)

**Mora, A.** Plywood; Veneer

**Mordell, Albert.** Hearn, Lafcadio (*in part*); Whittier, John Greenleaf

**Morehead, Albert H.** Auction Bridge (*in part*); Baccarat, Boston (*in part*); Bridge (*in part*); Canasta; Cards, Playing; Chouette; Contract Bridge (*in part*); Faro; Gaming and Wagering; Lotto (*in part*); Poker; Roulette; Rummy; Whist (*in part*)

**Morfill, William Richard.** Nestor

**Morgan, Arthur E.** Antioch College

**Morgan, Conwy Lloyd.** Emergence

**Morgan, Edward Victor.** Banking (*in part*); Great Britain (*in part*)

**Morgan, Edwin George.** Scottish Literature (*in part*)

**Morgan, Frank.** Motion Pictures (*in part*)

**Morgan, Sir Gilbert Thomas.** Acenaphthene; Aldehydes (*in part*); Amines (*in part*); Antipyrine (*in part*); Atomic Number; Britannia Metal; Gallium; Germanium; Hydrate (*in part*); Ketenes (*in part*); Ketones (*in part*); Lactic Acid; Metallic Carbonyls; Metallic Compounds (*in part*); Organic Pyrazoles (*in part*); Pyrogallol; Salicylic Acid; Scandium; Stilbene; Succinic Acid; Sulphonic Acids; Tarta (*in part*); Tartaric Acid (*in part*); Thiazoles; Thorium; Triphenylmethane; Type Metal; Vanadium

**Morgan, Brigadier General John Hartman.** Attorney-General (*in part*); By-Law or Bye-Law (*in part*); Common Law; Constitution and Constitutional Law (*in part*); Martial Law (*in part*); Official Secrets; Petition of Right (*in part*); Prerogative; Public Authorities Protection Act; State, Act of

**Morgan, Thomas Hunt.** Lamarckism

**Morgan, William Wilson.** Campbell, William Wallace; Kapteyn, Jacobus Cornelius; Rigel; Saturn (*in part*); Struve, Friedrich Georg Wilhelm

**Morgenstern, William V.** Chicago, The University of

**Morgenthau, Hans J.** Authoritarianism; Peace, International; Spheres of Influence; Ultimatum

**Morison, Robert Swain, M.D.** Hypothalamus and Thalamus

**Morison, Stanley.** Calligraphy; Printing Type (*in part*); Typography

**Morley, Christopher.** Henry, O.

**Morley of Blackburn, John Morley, 1st Viscount.** Burke, Edmund; Comte, Auguste (Isidore Auguste Marie François Xavier) (*in part*); Diderot, Denis (*in part*)

**Morrell, R. S.** Carmine (*in part*)

**Morrill, Elliott.** Incendiary Mixtures

**Morris, Frances.** Lace (*in part*)

**Morris, Geoffrey Christopher.** Prime Minister, British (*in part*)

**Morris, Richard B.** Whiskey Insurrection, The

**Morris, Robert W.** Electric Lamps, Manufacture of (*in part*)

**Morrison, Frank Barron.** Feeding Stuffs and Livestock Feeding

**Morrow, H. L.** Street Cries

**Morrow, Ian F. D.** Baden (land) (*in part*); Beust, Friedrich Ferdinand von; Black Sea (*in part*); Cambon, Pierre Paul; Cambridge, Clarence... George William Frederick Wellers, 4th Earl of; Dardanelles; Eulenburg-Hertefeld, Philip zu, Prince and Count (*in part*); Tirol (*in part*)

**Morse, John Torrey, Jr.** Holmes, Oliver Wendell

**Morse, Richard Stetson.** Vacuum (*in part*)

**Mortensen, Brita Maud Ellen.** Swedish Language and Literature

**Mortimer, Herbert Clifford.** Divorce (*in part*)

**Morton, George Ashmun.** Television (*in part*)

**Morton, Hudson T.** Bearings

**Morton, J. V.** Chartreuse (*in part*); Crème de Menthe; Curaçao

**Morton, W. E.** Cotton and the Cotton Industry (*in part*)

**Moss, John.** Social Security (*in part*)

**Mott, Frank Luther.** Journal; Journalism; News Agency (*in part*); Newspapers (*in part*), Periodical (*in part*); Syndicate, Press; Weed, Thurlow

**Mott, Sir Frederick Walker, M.D.** Neuropathology

**Mott, Nevill Francis.** Electricity, Conduction of (*in part*)

**Mottern, Hugh H.** Vinegar

**Mott-Smith, Geoffrey.** Backgammon; Chess (*in part*); Cribbage; Nine Men's Morris

**Mountevans, Admiral Edward Ratcliffe Garth Russell Evans, 1st Baron.** Observer Corps in Air Defense (*in part*)

**Mousnier, Roland Émile.** France (*in part*)

**Moyer, John William.** Taxidermy (*in part*)

**Moyes, Rt. Rev. Monsignor J., D.D.** Pius XI (*in part*)

**Mudge, George Percival.** Incubators (*in part*)

**Muehlberger, Clarence Weinert.** Drunkenness

**Mueller, George Vernon.** Electric Generator; Electric Power Generation

**Muenscher, Walter Conrad.** Convolvulus; Dandelion (*in part*); Poison Ivy, Poisonous Plants; Thistle, Water-Hemlock; Weeds (*in part*)

**Muhlfeld, John E.** Locomotive (*in part*); Locomotive Coaling (*in part*)

**Muir, Ramsay.** Liberal Party (*in part*)

**Muirhead, James Fullarton.** Huggenberger, Alfred (*in part*), Spitteler, Carl

**Muirhead, John Henry.** Idealism

**Mulford, Herbert B.** Cornerstone

**Mulholland, John.** Conjuring

**Muller, Hermann Joseph.** Gene; Variation (*in part*)

**Mullinger, James B.** Universities (*in part*)

**Mumford, Lewis.** Regional Planning (*in part*)

**Munk, Walter Heinrich.** Waves of the Sea

**Munro, Dana C.** Rome (*in part*)

**Munro, Neil.** Conrad, Joseph

**Murdock, Kenneth Ballard.** Longfellow, Henry Wadsworth, Mather, Cotton; Mather, Increase; Mather, Richard

**Murphy, Edward L., S.J.** Asceticism

**Murphy, Edwin S.** Salvage (*in part*)

**Murphy, Frank.** Government Departments (*in part*)

**Murphy, Howard A.** Music, Teaching of (*in part*)

**Murray, Alexander Stuart.** Lamp (*in part*)

**Murray, Arthur.** Dance (*in part*)

**Murray, David Leslie.** Beaconsfield, Benjamin Disraeli, Earl of

**Murray, George Gilbert Aimé.** Drama (*in part*); Euripides; Homer; Homeric Poems

**Murray, John Courtney, S.J.** Extreme Unction; Holy Spirit, The (*in part*)

**Murray, Margaret Alice.** Witchcraft

**Murray, Peter John.** Wilkie, Sir David

**Muskat, Irving E.** Alkali Manufacture (*in part*)

**Mussey, Henry R.** Protection (*in part*)

**Muzzey, David Saville.** United States (of America), The (*in part*)

**Myatt, Edward.** Stock Exchange (*in part*)

**Myers, Earl Hamlet.** Foraminifera

**Myres, Sir John Linton.** Argos (*in part*), Corfu (*in part*), Crete (*in part*); Euboea or Negroponte; Cyprus; Oxford; Paphos; Salamis; Troy and Troad (*in part*)

**Nabholz, Hans.** Switzerland (*in part*)

**Naismith, James, M.D.** Basketball (*in part*)

**Nalder, W. H.** Irrigation (*in part*)

**Namias, Jerome.** Isentropic Charts; Weather Forecasting

**Nansen, Fridtjof.** Refugees and the Exchange of Populations (*in part*)

**Nash, Charles P., Jr.** Laws Relating to Seamen (*in part*)

**Nasmith, Frank.** Cotton and the Cotton Industry (*in part*)

**Nathan, George Jean.** Drama (*in part*)

**Navarro, J. M. de.** Hallstatt; Teutonic Peoples (*in part*)

**Naylor, Henry Darnley.** New South Wales (*in part*), Queensland (*in part*)

**Nearing, G. G.** Lichens (*in part*)

**Needham, Joseph.** Hopkins, Sir Frederick Gowland (*in part*)

**Needham, Rodney.** Punan

**Neely, Wayne C.** Fair (*in part*)

**Neff, Grover C.** Electrification, Rural (*in part*)

**Negus, Victor Ewings.** Voice (*in part*)

**Nehmer, Stanley.** Agana; Guam (*in part*); Korea (*in part*); Samoa; Yap

**Neiburger, Morris.** Inversion of Temperature

**Neifeld, M. R.** Money-Lending (*in part*)

**Neilson, William Allan.** Smith College

**Neilson, Winthrop C.** Bauxite (*in part*)

**Nerlove, S. H.** Dividends

**Nevins, Allan.** Ford, Henry; Hearst, William Randolph; Pulitzer, Joseph (*in part*); Roosevelt, Franklin Delano (*in part*); Washington, George

**Newbigin, Marion I.** Albania (*in part*); Balkan Peninsula (*in part*); Bulgaria (*in part*); Greece (*in part*); Yugoslavia (*in part*)

**Newcomb, John Lloyd.** Virginia, University of

**Newcomb, Simon.** Neptune (*in part*); Velocity of Light (*in part*)

**Newcomer, Mabel.** Taxation, Local

**Newhall, Beaumont.** Photography (*in part*)

**Newman, Horatio H.** Twins and Twinning

**Newman, Melvin Spencer.** Anthraquinone (*in part*); Phenanthrene; Quinones

**Newsome, Albert R.** North Carolina (*in part*)

**Newth, John Douglas.** Schweitzer, Albert

**Ney, Lieutenant Colonel Virgil.** Volunteers

**Neyman, R. L.** Gunnery, Naval (*in part*)

**Nichol, F. D.** Miller, William; Seventh-day Adventists

**Nichol, John.** Burns, Robert

**Nicholas, Herbert George.** Baldwin, Stanley Baldwin, 1st Earl, of Bewdley (*in part*); Cabinet, The (*in part*); Churchill, Sir Winston Leonard Spencer; English History (*in part*); Government Departments (*in part*); Prime Minister, British (*in part*); Secretary of State

**Nichols, John T.** Barracuda; Fishes (*in part*); Grunt; Lancet Fish; Lion Fish; Mamamu; Moorish Idol, Poison Fish; Scorpion Fishes; Squirrel Fishes

**Nichols, Joseph C.** Ice Hockey (*in part*)

**Nichols, Roy Franklin.** Taylor, Zachary

**Nicholson, Edward Max.** Birds (*in part*)

**Nicholson, Edward Williams Byron.** Mandeville, Jehan De (*in part*)

**Nicholson, James T.** Red Cross (*in part*)

**Nicholson, Seth Barnes.** Neptune (*in part*); Pluto

**Nickerson, Hoffman.** War (*in part*)

**Nicoll, John Ramsey Allardyce.** Drama (*in part*)

**Nicolle, John Macarthur.** Buoy (*in part*)

**Nicolson, Hon. Harold.** Hugo, Victor
**Nightingale, Gordon Thayer.** Pineapple
**Nilsson, Martin P.** Calendar (*in part*)
**Nimitz, Fleet Admiral Chester William.** United States Naval Academy
**Nimkoff, Meyer F.** Illegitimacy
**Nisbet, H.** Angola; Brocade & Cotton; Calico, Cashmere; Charmeuse, Cheviot Cloth; Delaine; Flannelette (*in part*); Fustian; Gabardine; Georgette; Harris Tweed, Marocain; Moiré, Prunella; Satin, Schappe; Serge; Shantung; Silk Fabrics, Artificial; Tweed; Velvet; Velveteen; Vicuña
**Nitch, Cyril Alfred Rankin.** Urology
**Nixon, Roy Wesley.** Date Palm
**Noach, Arnoldus.** Keyser, Hendrik de; Post, Pieter
**Noble, G. Kingsley.** Amphibia (*in part*); Caecilian (*in part*)
**Noble, G. L.** Four-H Clubs
**Noel, Evan Baillie.** Fives, Rackets or Racquets (*in part*); Squash Rackets (*in part*)
**Noel-Baker, Philip J.** Sanctions and Guarantees (*in part*)
**Noffsinger, John Samuel.** Correspondence Schools
**Nohara, Daisuke.** Yokohama Specie Bank, Ltd, The
**Noldeke, Theodor.** Arabic Literature (*in part*); Mo' Allaqāt or Mu' Allaqāt (*in part*); Pahlavī or Pehlevi (*in part*); Persepolis (*in part*)
**Nollau, Edgar Hugo.** Leather, Artificial
**Noller, Carl Robert.** Benzoic Acid; Saponins and Sapogenins
**Nordberg, Bruno Victor.** Diesel Engine
**Norgate, G. Le G.** Chelmsford, Frederick John Napier Thesiger, 1st Viscount
**Norman, Arthur Geoffrey.** Rothamsted Experimental Station
**Norman, Sylva.** English Literature (*in part*)
**Normanton, Helena Florence.** Women, Legal Position of (*in part*); Women's Suffrage (*in part*)
**Norris, Francis Benedict Vincent.** Droit Administratif
**North, Frederick J.** Slate
**North, Brigadier General Thomas.** World War II (*in part*)
**Northedge, Frederick Samuel** International Trade Associations and Congresses
**Norton, Charles Eliot.** Curtis, George William
**Norton, L. J.** Federal Farm Board
**Norwood, Edwin P.** Circus (*in part*)
**Novák, Arne.** Czech Language and Literature (*in part*)
**Noyce, (Cuthbert) Wilfrid Francis.** Everest, Mount (*in part*)
**Noyes, Pierrepont Burt.** Oneida Community
**Nuelle, Joseph Henry.** Delaware and Hudson Company, The
**Nuffield of Nuffield, William Richard Morris, 1st Viscount.** Morris Motors Limited
**Nunes, Leo George.** Épée Fencing; Fencing; Foil Fencing, Sabre Fencing (*in part*)
**Nurkse, Ragnar.** Reichsbank (*in part*)
**Nutting, Charles B.** Statute (*in part*)

**Oakeley, Hilda Diana.** Personality
**Oakley, Kenneth Page.** Neanderthal Man
**O'Brien, George.** Shannon
**O'Brien, Morrough P.** Coast Protection and Land Reclamation (*in part*)
**O'Connell, Rev. Daniel,** S.J. Newman, John Henry (*in part*)
**O'Connor, William R.** Confirmation
**Odishaw, Hugh.** Standards, National Bureau of
**O'Donnell, Thomas C.** Friendly Societies (*in part*)
**Oehser, Paul H.** North America (*in part*); United States (of America), The (*in part*)
**Oelsner, Hermann.** Italian Literature (*in part*); Provençal Language and Literature (*in part*)
**Oertzen, Karlludwig von.** Schlieffen, Alfred
**Oesper, Ralph Edward.** Armstrong, Henry Edward, Arrhenius, Svante August (*in part*), Berthelot, Marcelin Pierre Eugène (*in part*); Berthollet, Claude Louis (*in part*), Berzelius, Jons Jakob (*in part*), Black, Joseph (*in part*), Cannizzaro, Stanislav; Crookes, Sir William (*in part*), Dumas, Jean Baptiste André, Fresenius Karl Remigius, Glauber, Johann Rudolf; Graham, Thomas; Haber, Fritz, Henry, William; Hofmann, August Wilhelm von, Kolbe, Hermann, Le Bel, Joseph Achille, Mitscherlich, Eilhardt; Nernst, Walter, Nobel, Alfred, Ostwald, Wilhelm, Perkin, William Henry, Jr; Priestley, Joseph (*in part*); Raoult, François Marie; Richards, Theodore William; Stahl, Georg Ernst; Werner, Alfred; Wislicenus, Johannes; Wohler, Friedrich; Wollaston, William Hyde
**Oesterley, William W. O. E. D.** Apocalyptic Literature (*in part*); Assumption of Moses (*in part*); Baruch (*in part*), Enoch, Book of (*in part*); Ezra, Fourth Book (or Apocalypse) of (*in part*); Isaiah, Ascension of; Jubilees, Book of (*in part*); Judith, The Book of (*in part*), Manasses, Prayer of (*in part*); Sibylline Oracles (*in part*)
**Offner, W. W.** Magnetic Inspection
**Ogden, Charles Kay.** Basic English
**O'Hara, Captain Charles E.** Investigation, Criminal (*in part*)
**Ohly, John Hallowell.** Government Departments (*in part*)
**O'Huadhaigh, Seán.** Arbitration (*in part*)
**Okey, Thomas.** Basket (*in part*); Osier (*in part*)
**Olcott, Frances J.** Children's Books (*in part*)
**Oldfield, Lieutenant Colonel Josiah, M.D.** Vegetarianism
**Olds, George D.** Amherst College
**Oliver, Francis Wall.** Spartina
**Olivier, Charles P.** Meteor (*in part*)
**Ollis, William David.** Pyrones
**Olson, Elder J.** Criticism; Verse
**Olson, James C.** Nebraska
**Oltar-Jevsky, W.** Russian Architecture (*in part*)
**O'Malley, L. S.** Khasi and Jaintia Hills (*in part*)
**Oman, Sir Charles (William Chadwick).** Hundred Years' War, The; Mohammedan Campaigns
**O'Neill, John Johnston.** Adams, Frank Dawson
**Onions, Charles Talbut.** Gloss and Glossary (*in part*)
**O'Reilly, M.** Scandinavian Civilization (*in part*)
**Orlemann, Edwin F.** Iron
**Ormerod, Robert M.** Belting for Power Transmission (*in part*)
**Ormsby, (Mrs.) Hilda.** London (*in part*)
**Orthmann, August Caesar.** Leather, Care of
**Osborn, E. B.** Boxing (*in part*)
**Osborne, J. H.** Fire Engines (*in part*); Fire Escapes (*in part*)
**Osburn, Raymond C.** Kamptozoa; Polyzoa (*in part*)
**Osgood, Herbert Levi.** United States (of America), The (*in part*)
**Osgood, Wilfred Hudson.** Zoological Nomenclature
**Osler, Abraham G.** Wassermann Reaction.
**Osmun, William.** Thornhill, Sir James; West, Benjamin
**Oswald, John Clyde.** Printing (*in part*)
**Ott, Emil.** Cellulose
**Overacker, Louise.** Primaries
**Overbeek, Jan Theodoor Gerard.** Colloids (*in part*)
**Overdijkink, Gerrit Willem.** Malay Archipelago (*in part*)
**Overholser, Winfred, M.D.** Psychiatry (*in part*)
**Overstraeten, Major R. van.** Antwerp, Siege of; Belgium, Invasion of (1914), Yser, Battle of the (*in part*)
**Overton, Sir Arnold.** Trade: World Statistics (*in part*)
**Owen, Benjamin Evan.** Hopkins, Gerard Manley
**Owen, Captain B. J.** Sheep Shearing Machines (*in part*)
**Owen, Sidney George.** Ovid (*in part*)
**Owens, Hamilton.** Baltimore
**Owens, Ralph G.** Electrical Machine (*in part*)
**Ower, Ernest.** Anemometry (*in part*)
**Owsley, William D.** Drilling, Petroleum

**Pacaut, Marcel Pierre.** Bouvines, Champagne (*in part*); Dauphin (*in part*); Louis IX (*in part*), Nivernais, Paris (*in part*), Paris University; Provence (*in part*)
**Pack, George T., M.D** Cancer
**Packard, Arthur J.** Hotel (*in part*)
**Page, Sir Charles Max.** Fractures
**Page, Theodore Stephen.** Censorship (*in part*)
**Paget, Sir Richard Arthur Surtees.** Voice Sounds
**Paige, John H.** Lacrosse
**Paine, S. G.** Bacteriology
**Palache, Charles.** Goldschmidt, Victor
**Palat, Barthélemy Edmond.** Champagne, Battles in (*in part*), Frontier, Battles of The (*in part*)
**Paléologue, Maurice.** Romanoff Dynasty
**Pall, Gordon.** Numbers, Theory of
**Palmer, B. C.** Taximeter
**Palmer, Elbridge Woodman.** Bookbinding (*in part*)
**Palmer, Howard.** Rocky Mountains, The
**Palmer, John Leslie.** Lenormand, Henri-René (*in part*); Molière
**Palmer, Paul F., S.J.** Confession; Indulgence
**Paneth, Frederick Adolphus.** Meteorites
**Pantin, John.** Ink (*in part*)
**Paoli, Cesare.** Siena (*in part*)
**Pardee, Joseph Thomas.** Phosphate Rock
**Parente, Pascal P.** Statistical Methods
**Parish, William F.** Friction; Lubricants; Lubrication
**Park, Marion Edwards.** Bryn Mawr College (*in part*)
**Park, Orlando.** Ecology, Animal
**Park, Thomas.** Fertility and Fecundity (*in part*); Population Ecology
**Parker, Rt. Hon. Charles Stuart.** Peel, Sir Robert
**Parker, Eric.** Shooting (*in part*)
**Parker, George Howard.** Comparative Nervous System
**Parker, H. W.** Gecko; Iguana; Lizard (*in part*); Python (*in part*); Sea Serpent; Snakes (*in part*), Turtle (*in part*)
**Parker, Ralzemond Drake.** Telephotography
**Parker, William Belmont.** Atahuallpa or Atabalipa; Bustamante, Antonio Sánchez de (*in part*), Cespola, Luigi Palma di; Concepciones, Quesada, Francisco Vasquez de, Durao, José de Santa Rita, Francia, José Gaspar Rodríguez (*in part*), Guzmán Blanco, Antonio, Hernández, José; Iturbide, Augustin de, Jiménez de Quesada, Gonzalo, Las Casas, Bartolomé de; Leguía, Augusto B., López, Francisco Solano, Maximilian (Ferdinand Maximilian); Medina, José Toribio (*in part*); Mendoza, Antonio de; Mitre, Bartolomé, Olmedo, José Joaquín de, Paez, José Antonio; Palma, Ricardo; Pedro II; Rodó, José Enrique; Rosas, Juan Manuel de (*in part*); San Martín, José de; Sarmiento, Domingo Faustino; Sucre, Antonio José de
**Parker-Smith, A.** Patents (*in part*)
**Parkes, Arthur Josiah.** Lock
**Parkinson, Cyril Northcote.** Gambier, James Gambier, Baron; Hoste, Sir William; Hotham, William Hotham; Great Britain (*in part*); Malaya (*in part*); Singapore
**Parlett, Sir Harold George.** Japanese Language
**Parmelee, Julius H.** Railways (*in part*)
**Parmer, Raymond.** Laws Relating to Seamen (*in part*)
**Parmin, Charles.** Lisieux
**Parran, Thomas, M.D.** Preventive Medicine
**Parrington, Vernon Louis.** Hawthorne, Nathaniel
**Parry, John Horace.** Jamaica (*in part*)
**Parsons, Edward Alexander.** Louisiana
**Parsons, Frederick Gymer.** Anatomy (*in part*);

Arteries; Joints and Ligaments (*in part*); Liver, Anatomy of, Lymphatic System; Mouth and Salivary Glands (*in part*), Muscular System, Anatomy of, Nerve (*in part*), Nervous System; Olfactory System (*in part*), Pancreas, Pharynx, Reproductive System (*in part*), Respiratory System, Anatomy of, Scalp, Skeleton (*in part*), Skull; Spinal Cord (*in part*); Teeth; Veins
**Parsons, James Bayard.** Alkali; Aludel, Alumina, Anion, Cation, Chemistry (*in part*); Copperas, Dalton's Law; Efflorescence, Elements, Chemical; Equivalent; Glauber's Salt, Hydrosulphite of Soda; Isotopes (*in part*), Parvise, Plaster of Paris, Sodium (*in part*); vitriol
**Parsons, Wilfrid, S J** Democracy (*in part*)
**Partington, James Riddick.** Nitrogen
**Paschkis, Victor.** Electric Furnaces
**Passant, E. J.** Consul (*in part*); Foreign Office (*in part*)
**Pastor, Antonio R.** Spanish Language and Literature (*in part*)
**Pastor, Ludwig von.** Papacy (*in part*)
**Paterson, James Alexander, D.D.** Numbers (*in part*)
**Paton, Rev. W.** Missions (*in part*)
**Patrick, Walton R.** Short Story
**Patterson, Buel R.** Wrestling (*in part*)
**Patterson, Frederick Douglas.** Tuskegee Institute
**Patterson, Richard S.** Seals (*in part*)
**Patterson, Woodford.** Cornell University (*in part*)
**Pattison, Rev. Mark.** Erasmus, Desiderius (*in part*), Grotius, Hugo (*in part*); Macaulay, Thomas Babington Macaulay, Baron (*in part*)
**Patton, C. L.** Pinocle
**Paues, Anna C.** Bible, English (*in part*)
**Pauling, Linus Carl.** Ice; Periodic Law; Resonance, Theory of; Valence (*in part*)
**Paull, Wallace H.** Tyre (*in part*)
**Paulsen, Carl G.** Physical Natural Resources (*in part*)
**Paxson, Frederic Logan.** American Frontier, The; Middle West, The (*in part*)
**Payne, Joseph Frank, M.D.** Plague (*in part*)
**Peacock, David Henry.** Camphor, Terpenes
**Peake, Arthur Samuel, D D** Bible (*in part*)
**Peake, Harold John Edward.** Archaeology (*in part*)
**Pear, Tom Hatherley.** Imagery
**Pearl, Raymond.** Death, Biological Aspects of
**Pearman, J. B.** Bowls (*in part*), Croquet (*in part*), Handball (*in part*)
**Pearn, Bertie Reginald.** Bengal (*in part*); Burma (*in part*); Central Provinces and Berar (*in part*)
**Pearson, H. S.** Pecora
**Pearson, Paul Martin.** Lyceums and Chautauquas
**Pearson, Ralph.** Woodcuts and Wood-Engraving
**Pearson, Sir Ralph Sneyd.** Timber Preservation
**Peat, Stanley.** Carbohydrates (*in part*)
**Peck, Edson R.** Arson (*in part*)
**Peck, Mary Gray.** Catt, Carrie Lane Chapman
**Pederson, C. J.** Antioxidants
**Peek, Frank W., Jr.** Electrical Power Transmission (*in part*); Transformer (*in part*)
**Peekema, Wibo G.** Banka (*in part*)
**Peel, Dorothy Constance (Mrs. C. S.).** Pastry, Home Made
**Peele, Robert.** Blasting (*in part*); Boring; Shaft-Sinking (*in part*)
**Peers, Edgar Allison.** Drama (*in part*); Franco Bahamonde, Francisco
**Peery, William.** Field, Nathan
**Peet, Louise Jenison.** Refrigerators (Household) (*in part*)
**Peet, T. Eric.** Calendar (*in part*)
**Peffer, E. L.** Hydrometers (*in part*)
**Peirce, Hayford.** Byzantine Art (*in part*)
**Peissi, Pierre.** Forges, Comité des
**Pelham, Henry Francis.** Augustus; Nerva Marcus Cocceius (*in part*); Rome (*in part*)
**Pemberton, Ralph, M D** Massage
**Penderel-Brodhurst, James.** Bed (*in part*); Cabinet; Chair, Clocks (*in part*); Desk; Pawnbroking, Vernis Martin
**Pendleton, Robert L.** Tropical Agriculture
**Pennell, Elizabeth Robins.** Lithography (*in part*)
**Pennock, Grace L.** Housekeeping (*in part*)
**Pennock, J. Roland** Administrative Regulation
**Penson, Lillian Margery.** Colony
**Penzer, Norman Mosley.** Zinc (*in part*)
**Percival, John.** Wheat (*in part*)
**Perham, H. N.** Bayonet (*in part*)
**Perkins, Arthur George.** Dyes, Natural; Fustic, Yellow Wood or Old Fustic, Indigo (*in part*), Lac Dye, Logwood; Persian Berries; Purple, Quercitron Bark, Weld
**Perkins, Charles A.** Third Degree (*in part*)
**Perlman, Selig.** Closed Shop; Company Unions; Labour Exchange (*in part*); General Strike (*in part*); Trade Board (*in part*); Trade (Labour) Unions (*in part*)
**Perrin, Jean.** Brownian Movement
**Perry, Chesley R.** Rotary Club (*in part*)
**Perry, Janet.** Spanish Language and Literature (*in part*)
**Pershing, General John Joseph.** Meuse-Argonne Operation; St Mihiel (*in part*); United States (of America), The (*in part*)
**Petch, James Alexander.** Examinations (*in part*)
**Peters, Fredus Nelson, Jr.** Furan, Furfural
**Peterson, Florence.** Labour Turnover
**Peterson, Mildred Othmer.** Libraries (*in part*)
**Peterson, Ralph G.** Cafeteria
**Peterson, Roger T.** Birds, Protection of (*in part*)
**Petrie, Sir William M. Flinders.** Measures and Weights, Ancient; Pyramid, Sequence Dating
**Petrunkevitch, Alexander.** Acarus; Arachnida; Black Widow, Eurypterida; Pedipalpi; Pentastomida, Scorpion, Spiders; Whip Scorpion, Xiphosura
**Pettijohn, F. J.** Sandstone
**Pew, Marie Elizabeth,** Reporting (*in part*)
**Pfeiffer, George A.** Polygons (*in part*), Solids, Geometric
**Pfister, Christian.** Antrustion, Austrasia, Capitulary, Carolingians, Charibert, Charles Martel; Childebert; Childeric, Clotaire; Clotilda, Saint, Clovis, Dagobert I, Franks; Fredegond; Germanic Laws, Early (*in part*); Gregory, St of Tours; Hunald; Mayor of the Palace, Pippin or Pepin; Salic Law (*in part*), Sigebert
**Phair, William A.** Iron and Steel (*in part*)
**Phelps, Henry Willis.** American Can Company, The
**Phelps, William Lyon, D D.** Cooper, James Fenimore
**Philbrick, Francis Samuel.** American Law (*in part*), Declaration of Independence; Hamilton, Alexander; Jefferson, Thomas
**Philby, Harry St. John Bridger** Arabia (*in part*); Bell, Gertrude Margaret Lowthian; Hadhramaut (*in part*), Hasa (*in part*); Ibn Sa'ud 'Abd ul-'Azīz ibn 'Abd ur-Rahman ibn Faisal (*in part*), Jidda (*in part*); Kuwait (*in part*)
**Phillimore, George Grenville.** Burial (*in part*)
**Phillimore, Walter George Frank Phillimore, 1st Baron.** Admiralty, High Court of; Admiralty Jurisdiction (*in part*), Advowson
**Phillips, Catherine Beatrice.** Marie Antoinette (*in part*)
**Phillips, Rev. Charles Stanley.** Edward "The Confessor"
**Phillips, C. John.** Glass (*in part*); Glass Manufacture
**Phillips, Everett Franklin.** Bee (*in part*), Honey
**Phillips, Gilbert Paul.** Australia (*in part*)
**Phillips, Rev. Theodore Evelyn Reece.** Jupiter; Mercury, Neptune (*in part*), Saturn (*in part*); Venus
**Phillips, Brigadier General Thomas Raphael.** Tactics (*in part*)
**Phillips, Walter Alison** Aix-La-Chapelle, Congresses of, Alexander I (Aleksander Pavlovich), Alliance, Balance of Power, Baron; Berlin, Congress and Treaty of, Brest-Litovsk, Treaties of, Canon (*in part*), Carlsbad Decrees, Church History (*in part*); Dalmatic; Dispensation; Dragon; Duke; Eastern Question, The, Esquire; Excellency; Faust or Faustus, French Revolution, The, Gentleman, Greek Independence, War of, Holy Alliance, The; Jacobins, The; King, London, Conferences of; Louis Philippe I, Magyars, Mahmud II (*in part*), Mephistopheles; Nibelungenlied; Nicholas I (*in part*); Paris, Treaties of; Schleswig-Holstein Question (*in part*), Templars (*in part*), Verona, Congress of; Vestments; Walther von der Vogelweide
**Philp, James.** Skye
**Phipson, Sydney Lovell.** Evidence (*in part*); Witness (*in part*)
**Piccirilli, Attilio.** Sculpture Technique (*in part*)
**Pickels, Edward Greydon.** Centrifuge
**Pickering, B. M.** Joel
**Pickford, Grace Evelyn.** Annelida (*in part*), Earthworm, Echiurida, Priapulida, Sipunculida, Vermes
**Pierce, Vivian.** Capital Punishment (*in part*)
**Pierce, W. Conway.** Chemistry (*in part*)
**Pieters, Adrian John.** Lespedeza (*in part*); Seed Trade (*in part*)
**Piggott, Major General Francis Stewart Gilderoy.** Enomoto (Yenomoto), Buyo, Yoshihito, Yoshizawa, Kenkichi
**Pike, Douglas Henry.** South Australia (*in part*)
**Pile, Seymour.** Brass
**Pillsbury, Donald M., M D** Psoriasis; Pruritus; Seborrhoea, Shingles; Skin Diseases
**Pillsbury, Walter Bowers.** Beneke, Friedrich Eduard, Cattell, James McKeen; Ebbinghaus, Herman; Janet, Pierre; Kulpe, Oswald
**Pines, Herman.** Butane, Olefin, Paraffin Hydrocarbons, Chemistry of
**Pinkerton, William M.** Harvard University (*in part*)
**Pinson, Koppel S.** Anti-Semitism (*in part*)
**Pirenne, Henri.** Belgium (*in part*)
**Pirenne, Jacques.** Belgium (*in part*)
**Pitt, Colonel Robert Brindley.** Cranes
**Pittioni, Richard.** La Tène; Terramara
**Plamenatz, John Petrov.** Pasic, Nikola
**Plass, Everett Dudley, M.D.** Obstetrics (*in part*)
**Plath, Karl.** Ptarmigan, Waxwing
**Platt, John Isaac.** Alps; Apennines (*in part*); Atlas Mountains; Caucasus (*in part*), Glacier; Jura, Liverpool (*in part*); Manchester (*in part*), St. Helena (*in part*)
**Platt, Raye R.** Andes; Orinoco; Patagonia (*in part*)
**Plummer, Rev. Charles.** Alfred or Aelfred (The Great), Anglo-Saxon Chronicle, Bede, Beda or Baeda
**Pocock, Reginald Innes.** Carnivora (*in part*); Edentata (*in part*); Fox (*in part*)
**Podmore, Frank.** Automatic Writing
**Poète, (César) Marcel.** Paris (*in part*)
**Poffenberger, Albert Theodore.** Advertising (*in part*), Applied Psychology
**Polanyi, Michael, M D.** Chemiluminescence
**Pole, Sir Felix John Clewett.** Great Western Railway Company (*in part*)
**Pollard, Albert Frederick.** Coverdale, Miles
**Pollard, Alfred William.** Bibliography, Book-Collecting (*in part*); Books (*in part*); Chaucer, Geoffrey; Colophon, Incunabula; Polyglott or Polyglot
**Pollard, Frederick Henry.** Oxide (*in part*)
**Pollock, Rt. Hon. Sir Frederick.** Contract (*in part*); Tort
**Pollock, Walter Herries.** Musset, Alfred de (*in part*)
**Polyak, Stephen L.** Basilar Membrane; Ear, Anatomy of, Eye, Human (*in part*)
**Poole, Austin L.** Tours (*in part*)
**Poole, Reginald Lane.** Wycliffe (or Wyclif), John (*in part*)
**Poole, Reginald Stuart.** Egypt (*in part*)

**Pope, Arthur Upham.** Bistam; Isfahan (*in part*); Persia (*in part*); Rugs and Carpets (*in part*)
**Pope-Hennessy, John Wyndham.** Mino Da Fiesole
**Popenoe, (Frederick) Wilson.** Avocado; Banana; Breadfruit; Jujube, Litchi, Mango; Papaya; Pomegranate
**Popham, Arthur E.** Aquatint; Etching (*in part*); Line Engraving
**Popovitch, Sava.** Russian Art
**Poppe, Nicholas N.** Mongolia (*in part*); Mongolian Language and Literature
**Porteous, Douglas Archibald.** Superannuation (*in part*)
**Porter, Alfred William.** Electrical (or Electrostatic) Machine (*in part*); Sky (*in part*); Surface Tension; Thermodynamics (*in part*)
**Porter, Horace** [illegible]oke, Coking and High Temperature Carbonization (*in part*)
**Porter, Kirk Harold.** State Government
**Porter, Leroy V.** New York Central System
**Porter, Rupert Howard.** Seed Testing
**Porteus, Thomas Cruddas.** Standish, Myles
**Possony, Stefan T.** Europe (*in part*)
**Postgate, John Percival.** Juvenal (Decimus Iunius Iuvenalis) (*in part*); Latin Literature (*in part*); Phaedrus (*in part*); Propertius, Sextus, Textual Criticism; Tibullus, Albius (*in part*)
**Postgate, Raymond William.** Bakunin, Mikhail, Blanqui, Louis Auguste, Chartism; Churchill, Charles; Cluseret, Gustave Paul; Combination Laws; Communism (*in part*); Delescluze, Louis Charles; Flourens, Gustave; Hunt, Henry; Leipzig, Battle of; Municipal Trading (*in part*), O'Connor, Feargus Edward; Peterloo, Place, Francis, Radical; Sabotage; Wilkes, John; Wine (*in part*)
**Potter, David Morris.** Long, Huey Pierce
**Potter, Edith Louise,** M.D. Foetal Disorders
**Potter, George Richard.** Switzerland (*in part*)
**Potter, Pitman Benjamin.** League of Nations
**Potthoff, Carl J.,** M.D. Artificial Respiration; First Aid to the Injured
**Poucher, William A.** Cosmetics (*in part*); Perfumes
**Poulton, Sir Edward Bagnall.** Darwin, Charles Robert; Mimicry
**Pound, Louise.** Ballad (*in part*)
**Poupardin, René.** Arles; Burgundy; Franche-Comté; Philip the Bold (*in part*); Philip the Good (*in part*); Provence (*in part*)
**Powell, Alfred Richard.** Coke, Coking and High Temperature Carbonization (*in part*)
**Powell, Raphael.** Breviary of Alaric
**Powell, Thomas Reed.** Constitution and Constitutional Law (*in part*)
**Power, E. A.** Fisheries (*in part*)
**Powers, William E.** Watershed
**Powicke, Sir Frederick Maurice.** Middle Ages, The
**Pratt, David D.** Tars, Low-Temperature (*in part*)
**Pray, Carl E.** Argentina (*in part*)
**Prendergast, J. S.** Galen
**Prescott, Joseph.** Joyce, James
**Pressey, Sidney L.** Psychology (*in part*)
**Prest, Alan Richmond.** Unemployment
**Prestage, Edgar.** Garrett, João Baptista da Silva Leitão de Almeida (*in part*); Goes, Damiao de (*in part*); Herculano de Carvalho E Araujo, Alexandre (*in part*), Lopes, Fernão (*in part*); Manuel de Mello, Dom Francisco (*in part*); Portuguese Literature (*in part*)
**Preston, Wheeler B.** Ceylon (*in part*); Gibraltar (*in part*); Great Britain (*in part*); Hong Kong (*in part*); Malta (*in part*); New Zealand (*in part*)
**Pribram, Alfred Francis.** Aehrenthal, Aloys Lexa Von, Austria, Empire of (*in part*); Berchtold von und zu Ungarschitz, Leopold; Renner, Karl
**Price, Charles C.** Friedel-Crafts-Reaction
**Price, Don K.** City Manager; General Strike
**Price, Emmett W.** Cattle (*in part*); Pig (*in part*); Sheep (*in part*)
**Price, Francis Douglas.** High Commission, Court of
**Price, Sir James Frederick George.** Dole (*in part*); Unemployment Insurance (*in part*)
**Price, Jo** [illegible]**trike** (*in part*); Trade Board (*in part*)
**Price, Robert.** Chapman, John
**Priebsch, Robert.** German Language
**Priest, Alan Reed.** Seals (*in part*); Theatre (*in part*)
**Prince, John Dyneley.** Chaldaea
**Prinet, Léon Jacques Maxime.** Beauharnais; Joinville (*in part*)
**Pring, John Norman.** Electricity, Conduction of (*in part*); Electrolysis (*in part*)
**Pringle, Henry Fowles.** Smith, Alfred Emmanuel
**Pringle-Pattison, Andrew Seth.** Mysticism (*in part*); Philosophy and Philosophical Studies; Scepticism (*in part*), Theosophy; Weber's Law
**Prior, Edward S.** Fine Arts
**Pritchett, Charles Herman.** Government Corporations, Government Departments (*in part*)
**Proudman, Joseph.** Tides
**Prunty, Merle C., Jr.** South, The
**Pryde, George Smith.** Scotland (*in part*)
**Przibram, Hans.** Heteromorphosis
**Pucci, Enrico, Monsignor.** Vatican, The
**Pugh, Rear Admiral H. L.,** M.D. Medical Service, Navy (*in part*)
**Purdom, Charles Benjamin.** Garden Cities (*in part*)
**Purves, John.** Symonds, John Addington
**Pusey, Merlo J.** Hughes, Charles Evans (*in part*)
**Putnam, Palmer.** Windmills and Wind Power
**Pycraft, W. P.** Egg (*in part*); Feather (*in part*); Hibernation, Nest (*in part*); Song Birds (*in part*)
**Pye-Smith, Philip Henry.** Harvey, William (*in part*)

**Quantius, Frances Wells.** Budget, Business (*in part*)
**Quick, Rev. Robert Herbert.** Froebel, Friedrich Wilhelm August (*in part*)
**Quiggin, Mrs. A. F.** Agriculture, Primitive; Basket (*in part*); Dress, Primitive, Dwellings, Primitive; Hunting and Fishing, Primitive (*in part*); Transport (*in part*)
**Quiggin, Edmund Crosby.** Patrick, St. (*in part*)
**Quigley, Hugh.** Allgemeine-Elektrizitäts-Gesellschaft
**Quiller-Couch, Sir Arthur Thomas.** Brown, Thomas Edward
**Quine, Willard Van Orman.** Frege, Gottlob
**Quirin, E. J.** Docks (*in part*); Dredges and Dredging (*in part*)

**Rabak, Frank.** Hop
**Rabin, Chaim.** Hebrew Literature
**Rabuffo, Vincent M.** Ice Cream (*in part*)
**Racham, Bernard.** Pottery and Porcelain (*in part*)
**Rackemann, Francis Minot,** M.D. Allergy
**Radhakrishnan, Sir Sarvepalli.** Indian Philosophy; Shcherbatsky, Fedor
**Rait, Sir Robert Sangster.** Casket Letters; Mary Queen of Scots (*in part*); Scotland (*in part*)
**Ralston, Robert Henry.** Salt (*in part*)
**Ramsay, Sir William Mitchell,** D.D. Smyrna (*in part*)
**Ramsaye, Terry.** Motion Pictures (*in part*)
**Ramsbottom, J.** Truffle
**Ramsdell, Lewis S.** Calcite; Diaspore; Haematite; Limonite; Molybdenite; Psilomelane; Smaltite, Smithsonite; Torbernite; Zincite; Zircon
**Ramsey, Frank Plumpton.** Russell, Bertrand Arthur William Russell (*in part*)
**Rand, Austin L.** Audubon, John James; Egret; Lapwing; Starling, Stonechat; Stork; Sunbird; Sun Bittern; Surfbird, Swallow; Swan
**Randall-MacIver, David.** Apulia (*in part*); Comacines, The; Este; Etruscans, The; Picenes, Sicily (*in part*), Villanovans
**Ransome, Arthur.** Trotsky, Lev Davidovich (*in part*)
**Rapkin, Chester.** Building (*in part*)
**Rappaport, Irving.** Hookworm
**Rasche, William Frank.** Vocational Training (*in part*)
**Rastall, Robert Heron.** Alabaster; Alluvium; Cerargyrite; Chert; Clay-With-Flints, Esker; Geology; Gypsum; Malachite; Oolite; Pegmatite; Quartz (*in part*), Tungsten or Wolfram
**Ratchford, B. U.** Debt Conversion
**Ratcliffe, Rev. E. C.** Eucharist (*in part*)
**Rathbone, Eleanor F.** Family (*in part*); Fawcett, Dame Millicent Garrett, G. B. E.
**Ratner, William.** Cycling (*in part*)
**Ravdin, I. S.,** M.D. Haemorrhage
**Raven, Henry Cushier.** Kangaroo
**Ravenstein, Ernest George.** Map (*in part*)
**Rawle, Francis.** Inheritance (*in part*)
**Rawlings, Arthur Lionel.** Gyroscope (*in part*)
**Rawlinson, Rt. Rev. A. E. J.,** D.D. Gospel; Mark, Gospel of
**Rawlinson, Hugh George.** Bombay (*in part*); Bombay State (*in part*)
**Ray, Sidney H.** Papuan Languages
**Rayleigh, John William Strutt, 3rd Baron.** Argon (*in part*); Sky (*in part*)
**Raymer, Robert George.** Velázquez (de Cuéllar), Diego
**Raymond, Cornelia M.** Vassar College (*in part*)
**Rayner, Mabel Mary Cheveley.** Mycorrhiza
**Rayton, Wilbur B.** Microscope
**Read, C. Stanford,** M.D. Hypochondriasis; Hysteria; Insanity (*in part*), Insomnia (*in part*)
**Read, Herbert.** Stained Glass (*in part*)
**Reavis, William C.** School Administration, U.S.
**Reboux, Paul.** Gastronomy, Modern
**Reckless, Walter C.** Criminology
**Reddaway, William Fiddian.** Norway (*in part*)
**Redden, Kenneth R.** Legitimacy and Legitimation (*in part*)
**Redden, William R.,** M.D. Bandages and Bandaging
**Redfield, Robert.** Durkheim, Emile
**Redmayne, Sir Richard Augustine Studdert.** Adit; Airway, Anthracite (*in part*); Cage; Choke-Damp, Coke, Coking and High Temperature Carbonization (*in part*); Firedamp; Gob and Gob Fires; Low-Temperature Carbonization; Peat; Pulverized Fuel; Royalties, In Mining
**Redway, George William.** Petersburg Campaign; Seven Days' Battle; Shenandoah Valley (*in part*)
**Reed, Clarence Arthur.** Almond; Cashew; Chestnut; Filbert; Hickory; Nut; Pecan; Pistachionut; Walnut
**Reed, Henry M.** American Radiator and Standard Sanitary Corporation
**Reed, Ollie Ezekiel.** Cheese (*in part*); Milk (*in part*)
**Reed, Thomas Harrison.** City Government
**Rees, James Frederick.** Commerce
**Rees, John Morgan.** Syndicalism (*in part*)
**Reeside, John Bernard, Jr.** Cretaceous System
**Reeve, Frank Driver.** New Mexico
**Reeves, Hon. William Pember.** Grey, Sir George (*in part*); New Zealand (*in part*)
**Régamey, Raymond.** Iron in Art (*in part*)
**Regan, C. Tate.** Cat-Fish; Char; Cichlid; Cod; Cyprinodonts; Eel (*in part*); Ray; Selachians; Shark
**Regna, Peter P.** Tartaric Acid (*in part*)
**Reid, Donald A. G.** Building (*in part*)
**Reid, Edwy B.** Agricultural Credit (*in part*)
**Reid, Sir George.** Turner, Joseph Mallord William (*in part*)
**Reid, James Smith.** Rutilius Claudius Namatianus; Statius, Publius Papinius (*in part*)

**Reid, Margaret G.** Consumption; Cost of Living (*in part*); Standard of Living
**Reid, Robert William,** M.D. Anatomy (*in part*)
**Reid, William Alfred.** A.B.C. Powers, Buenos Aires (*in part*)
**Reighard, Jacob.** Pisciculture (*in part*)
**Reiley, A. C.** Typewriter
**Reilly, Charles H.** Renaissance Architecture (*in part*)
**Reilly, Brigadier General Henry Joseph.** Artillery (*in part*)
**Reimann, Hobart Ansteth,** M.D. Pneumonia
**Reinhardt, Rev. Charles W.,** S.J. Old Catholics
**Reinhardt, Max.** Theatre (*in part*)
**Reinmuth, P. H. Otto.** Chemistry (*in part*); Grignard Reagents
**Reisman, Arthur.** Draughts or Checkers
**Reitell, Charles.** Scientific Management (*in part*)
**Reith of Stonehaven, John Charles Walsham Reith, 1st Baron.** Broadcasting (*in part*)
**Rembaugh, Bertha.** Arrest (*in part*); Bail (*in part*); Blackmail (*in part*); Bribery (*in part*)
**Rendle, Alfred Barton.** Angiosperms (*in part*); Leaf (*in part*)
**Renton, Sir Alexander Wood.** Arbitration (*in part*); Ejectment (*in part*); Emblements; Eminent Domain, Fixtures; Flat (*in part*); Ground Rent (*in part*); Inebriety, Law of (*in part*); Letters Patent, Lodger and Lodgings; Maxims, Legal, Proclamation; Rent; Trade Marks (*in part*); Waste
**Retzer, Robert.** Reinsurance (*in part*)
**Rew, Sir (R.) Henry.** Agricultural Prices (*in part*); Agricultural Statistics (*in part*); Farm Rents (*in part*); Land Tenure: Economic and Agrarian Aspects (*in part*); Open-
**Rex, Frederick Ferdinand.** Chicago (*in part*)
**Rey, Lieutenant Colonel Sir Charles Fernand.** Abyssinia (*in part*); Harar (*in part*); Kaffa; Tana
**Reyerson, Lloyd H.** Carbon, Oxides of
**Reynolds, Graham.** Water-Colour Painting (*in part*)
**Rhodes, George C.** Transatlantique, Compagnie Générale
**Rhys, Ernest.** Bookselling (*in part*)
**Ricci, Corrado.** Baroque Architecture
**Richards, A.** Embryo; Embryology (*in part*); Invertebrate Embryology
**Richards, George Warren,** D.D. Shakers (*in part*)
**Richards, Oscar W.** Incubators (*in part*)
**Richards, Theodore William,** M.D. Atom (*in part*)
**Richardson, Albert Edward.** Modern Architecture, 18th and 19th Centuries (*in part*)
**Richardson, C. A.** Pluralism
**Richardson, Charles Howard.** Entomology (*in part*)
**Richardson, H. Archie.** Hammer Throwing; Javelin Throwing; Jumping; Marathon Race; Putting the Shot
**Richardson, H. G.** Sheep Shearing Machines (*in part*)
**Richardson, John Henry.** Industrial Relations (*in part*)
**Richardson, John Reginald.** Cyclotron
**Richardson, Leopold John Dixon.** Sulpicia
**Richardson, Leo S.** Agricultural Societies and Shows (*in part*); Milk (*in part*); Soybean (*in part*)
**Richardson, Robert William.** Bayamo; Buenos Aires (*in part*); Catamarca (province) (*in part*); Cienfuegos (*in part*); Córdoba (*in part*); Cotopaxi (*in part*); Cuba (*in part*); Entre Ríos (*in part*); Jujuy (*in part*); Guaporé (*in part*); Oruro (*in part*); Iguassú (*in part*); Salta (*in part*); Lima (dept.); O'Higgins; Patagonia (*in part*); Plata, Rio de la or River Plate (*in part*); Rio Branco (*in part*); Salta (*in part*); San Juan (province) (*in part*); San Luis (*in part*); Santa Fé (province) (*in part*); Santiago del Estero (*in part*)
**Richardson, Wilds Preston.** Cordova (*in part*)
**Richter, Gisela Marie Augusta.** Gems in Art; Terra Cotta (*in part*)
**Richter, Irma A.** Bibiena (Bibbiena), Galli da (*in part*), Bouts, Dierick; Campin, Robert; Christus, Peter, Dosso Dossi, Giovanni; Duccio di Buoninsegna; Fermo, to, Paolo; Ferrari, Gaudenzio, Francesco, Anselm; Fiorenzo di Lorenzo, Franceschi, Piero de'; Gainsborough, Thomas, Gauguin, Paul; Ghirlandajo, Domenico, Gogh, Vincent Van; Goya y Lucientes, Francisco, Justus of Ghent, Liberale, Antonio; Lorenzetti; Luini, Bernardino; Mantegna, Andrea; Masaccio; Masolino da Panicale; Moretto, Il, Palma, Jacopo; Picasso, Pablo; Pisano, Vittore; Seurat, Georges, Solario, Andrea da, Theotocopuli, Domenico, Titian (*in part*); Uccello, Paolo, Veronese, Paolo; Vivarini
**Richter, Richard Biddle,** M.D. Delirium; Neuralgia
**Riddell, John R.** Colour Printing; Photogravure (Machine); Printing (*in part*)
**Riddle, Jackson W.,** M.D. Vaccine Therapy
**Ridenour, Louis Nicot, Jr.** Radar (*in part*)
**Ridgway, Raymond Ronald.** Silicon Carbide
**Ridgway, Robert.** Tunnel (*in part*)
**Ridley, General Clarence Self.** Panama Canal (*in part*)
**Riehl, Herbert.** Tropical Storms
**Riker, Dorothy Lois.** Indiana (*in part*); Indianapolis (*in part*)
**Ripault, Louis.** Herriot, Edouard (*in part*)
**Ripper, William.** Cutlery
**Rishbeth, O. H. T.** Australia (*in part*); New South Wales (*in part*), Queensland (*in part*); Tasmania (*in part*); Victoria (state) (*in part*), Western Australia (*in part*)
**Ritchie, Albert C.** Maryland (*in part*)
**Ritchie, James.** Sheep (*in part*)
**Ritson, John Anthony Sydney.** Safety Lamp (*in part*)
**Ritt, Joseph Fels.** Calculus, Differential and Integral (*in part*)
**Robb, Jane Sands,** M.D. Heart, Anatomy of
**Robb, R. Marion.** Phenazine
**Robbins, H. C.** Press Association, The
**Robbins, W. W.** Botany; Weeds (*in part*)
**Roberts, John Morris.** Italy (*in part*)
**Roberts, Mary M.** Nursing
**Roberts, Ray Harland.** Photoperiodism (*in part*)
**Roberts, Richard Ellis.** Ibsen, Henrik Johan
**Roberts, Sydney Castle.** Boswell, James; Johnson, Samuel (*in part*)
**Robertson, (Miss) A. J.** Anglo-Saxon Law (*in part*)
**Robertson, Alec.** Smetana, Bedrick
**Robertson Sir Charles Grant.** Reform Movement (*in part*)
**Robertson, Dennis Holme.** Trade Cycle (*in part*)
**Robertson, Edward,** D.D. Acre (*in part*); Ai; Baalbek; Bashan; Beelzebub; Damascus (*in part*); Dead Sea; Ekron; Endor; Gadara; Galilee, Galilee, Sea of; Gath; Gaza (*in part*); Gerasa, Gerizim; Gethsemane; Gezer; Gibeon; Gilead; Gilgal; Hama (*in part*); Hasbeya; Hebron (*in part*), Hermon, Homs or Hims; Jamnia; Jebeil; Jericho, Jerash; Joppa; Kerak; Lachish; Latakia, Marash (*in part*); Nazareth; Olives, Mount of; Ophir; Philadelphia (Rabbath-Ammon); Samaria; Shechem; Shiloh; Sidon; Sodom and Gomorrah; Tiberias; Tripoli (*in part*); Tyre; Uz, Johann Peter
**Robertson, James Alexander.** Philippine Islands (*in part*)
**Robertson, John George.** Eulenspiegel (Ulenspiegel), Till; Goethe, J. Wolfgang von; Grillparzer, Franz; Heine, Heinrich (*in part*), Meistersinger; Schiller, Johann Christoph Friedrich; Wieland, Christoph Martin
**Robertson, John Mackinnon.** Coleridge, Samuel Taylor; Shakespeare, William (*in part*)
**Robertson, John Monteath.** Argon
**Robertson, William Spence.** Venezuela (*in part*)
**Robins, C. A.** Idaho (*in part*)
**Robinson, B. B.** Jute (*in part*); Kapok; Ramie
**Robinson, Major General Sir Charles Walker.** Salamanca (*in part*); Vitoria (Spain)
**Robinson, Edgar Eugene.** United States (of America), The (*in part*)
**Robinson, Henry M.** Los Angeles (*in part*)
**Robinson, Rev. Henry Wheeler,** Hon. D.D. Canticles; Habakkuk, Holy Spirit, The (*in part*), Hosea, Malachi, Micah (*in part*); Obadiah, Psalms (*in part*); Zechariah
**Robinson, James Harvey.** Civilization
**Robinson, Lennox.** Yeats, William Butler
**Robinson, Maude.** Sculpture Technique (*in part*)
**Robinson, O. Preston.** Chain Store (*in part*)
**Robinson, Sir Robert.** Anthocyanins and Anthoxanthins (*in part*)
**Robinson, Theodore Henry,** D.D. Aaron; Adam, Ahab, Ammonites, Amos, Benjamin, Calf, The Golden, Deborah, Deuteronomy, Exodus, The, Gideon (*in part*); Jacob (*in part*), Jeremiah (*in part*); Jeroboam, Joseph, Josiah, Lamentations; Levites (*in part*), Moses (*in part*)
**Robinson, Will G.** South Dakota
**Robison, Admiral Samuel Shelburn.** Midshipman (*in part*)
**Robson, Guy Colwin.** Abalone (*in part*), Amphineura, Cephalopoda (*in part*), Cowry, Cuttlefish (*in part*); Gastropoda (*in part*); Lamellibranchia (*in part*), Mollusca (*in part*); Mussel (*in part*), Nautilus; Octopus; Periwinkle; Scallop (*in part*); Scaphopoda; Slug, Snail; Squid; Variation (*in part*); Whelk (*in part*)
**Rochow, Eugene George.** Silicone
**Rock, John,** M.D. Abortion
**Rockwell, William Walker,** D.Th. Boniface
**Rockwood, Nathan Chamberlain.** Aggregate; Cement (*in part*)
**Rodd, James Rennell, 1st Baron Rennell.** Egypt (*in part*)
**Rodebush, Worth Huff.** Dryness, Chemical
**Rodgers, William L.** Farragut, David Glasgow
**Roe, Frank Walton.** Borneo (*in part*)
**Rogers, Austin Flint.** Fulgurite
**Rogers, Philip George.** Germany (*in part*)
**Rogers, Tyler Stewart.** Glass Fibres
**Rolleston, Sir Humphry (Davy),** M.D. Goitre; Longevity (*in part*); Therapeutics
**Rollins, Reed C.** United States (of America), The (*in part*)
**Romanes, J.** Albertite; Bitumen; Ozokerite or Ozocerite
**Romberg, A. K.** Battleship (*in part*)
**Romer, Alfred S.** Brontosaurus; Dinosauria; Diplodocus; Labyrinthodontia; Ostracoderms; Palaeontology (*in part*); Stegosaurus; Triceratops
**Rooney, W. J.** Earth Currents
**Root, Elihu.** Permanent Court of International Justice
**Roover, Raymond de.** Money, Mediaeval
**Ropes, James Hardy,** D.D. Corinthians, Epistles to The, Ephesians, Epistle to The
**Rorem, Clarence Rufus.** Hospital
**Rosania, Luca.** Banca D'Italia; Stock Exchange (*in part*)
**Roscoe, Edward Stanley.** Sea Laws (*in part*); Wreck (*in part*)
**Rose, Arthur.** Distillation (*in part*)
**Rose, Charles Bedell.** Fire Engines (*in part*)
**Rose, Herbert Jennings.** Ancestor Worship; Annalists; Calendar (*in part*); Chronology (*in part*); Fate; Greek Literature (*in part*); Greek Religion (*in part*); Hera (*in part*); Hercules; Latin Literature (*in part*); Lycaon, Mystery (*in part*); Nemesis; Odysseus; Oedipus; Oracle (*in part*); Orestes; Prometheus (*in part*), Superstition, Thesmophoria; Vesta
**Rose, Horace Arthur.** Afridi (*in part*); Caste (Indian); India (*in part*); Sikhs
**Rose, John Holland.** English History (*in part*); Sieyès, Emanuel-Joseph (*in part*); Talleyrand-Périgord, Charles Maurice de
**Rose, John Kerr.** Apple; Barley; Beef (*in part*), Beer (*in part*), Bread (*in part*); Brewing (*in part*); Butter (*in part*); Canning, Commercial (*in part*); Cheese (*in*

*part*); Cocoa; Copra; Dairy Farming; Dry Farming (*in part*); Egg (*in part*); Ham; Meat (*in part*); Meat Trade; Mutton; Sheep (*in part*); Small Holdings; Sugar (*in part*); Vegetable; Wheat (*in part*); Wool
**Rose, Sir Thomas Kirke.** Amalgamation (*in part*); Cyanide Process, Gold Mining and Metallurgy; Mint (*in part*); Silver. Metallurgy, Mining and Production (*in part*)
**Rosenberg, Edward F.,** M.D. Rheumatoid Arthritis
**Rosenhain, Walter.** Metallography; Metallurgy (*in part*)
**Rosenwald, Julius.** Philanthropy (*in part*)
**Rosenzweig, Saul.** Projective Methods in Psychodiagnosis
**Ross, Charles Derek.** Mortimer
**Ross, Sir Edward Denison.** Bukhara (*in part*); Manchu Language; Turkish Language and Literature (*in part*)
**Ross, Herbert Holdsworth.** Stone Fly; Plecoptera
**Ross, Hugh Munro.** Alchemy (*in part*)
**Ross, Nellie Tayloe.** Mint (*in part*)
**Ross, R.** Great Britain (*in part*)
**Rosse, Herman.** Costume Design (*in part*)
**Rossetti, William Michael.** Perino del Vaga; Shelley, Percy Bysshe (*in part*), Tintoretto, Jacopo Robusti (*in part*); Titian (*in part*)
**Ross-Johnson, Dennis.** Port Operation (*in part*)
**Rost, Reinhold.** Tamils (*in part*)
**Rostas, Laszlo.** Customs Union; Exchange Control, Production, Census of (*in part*)
**Roth, Cecil.** Brampton or Brandon, Sir Edward; Jews (*in part*)
**Rothman, Stephen,** M.D. Tinea Versicolour
**Round, John Horace.** Aids; Baronet; Battle Abbey Roll; Bayeux Tapestry, The (*in part*); Beauchamp; Castle (*in part*); Clare (family); Court Baron; Domesday Book; Earl; Earl Marshal; Fitzgerald; Geoffrey De Montbray; Knight-Service, Lord Great Chamberlain; Marquess or Marquis; Scutage or Escuage; Serjeanty; Talbot (family) (*in part*)
**Rounsefell, George Armytage.** Herring
**Rouse, William Henry Denham.** Classical Education (*in part*)
**Roush, Gar A.** Briquetting (*in part*); Physical Natural Resources (*in part*)
**Roussin, Leander Gaspard.** Greece (*in part*)
**Rowan, William.** Birds, Migration of
**Rowe, Harold B.** War Control of Food (*in part*)
**Rowe, Leo S.** Pan American Conferences; Pan American Union
**Rowland, Dunbar.** Mississippi (*in part*)
**Rowland, Eron (Mrs. Dunbar Rowland).** McCord, Louise Susanna Cheves
**Rowntree, B. Seebohm.** Poverty Line; Welfare Work, Industrial
**Rowntree, Cecil.** Bone (*in part*)
**Roxby, Percy Maude.** Canton (*in part*); China (*in part*); Chin Hills; Manchuria (Manchoukuo) (*in part*); Mongolia (*in part*)
**Roy, Andrew Donald.** Cost of Living (*in part*)
**Royde-Smith, John Graham.** Lenclos, Ninon de
**Roys, Carl S.** Electric Waves; Radio Receiver
**Rubin, Isidor Clinton,** M.D. Sterility
**Rubinstein, Nicolai.** Italy (*in part*); Sicily (*in part*)
**Rudler, Frederick William.** Cat's-Eye; Celestine or Celestite; Marble (*in part*)
**Rudmose-Brown, R. N.** Arctic Regions (*in part*); New Siberian Islands; Nicholas, Northern or Lenin Land, Novaya Zemlya; Spitsbergen (*in part*), Wrangel Island
**Rudolf, G. R.** Average
**Rudolph, E. Leighton.** Arkansas
**Ruehe, Harrison August.** Butter (*in part*)
**Ruge, Raymond A.** Ice Yachting
**Rundle, Commander H. J. M.** Coast Guard (*in part*)
**Runner, Joseph James.** Bad Lands
**Russell, Bertrand Arthur William, 3rd Earl** Russell. Relativity Philosophical Consequences
**Russell, Sir (Edward) John.** Drainage of Land (*in part*)
**Russell, Elbert.** Friends, Society of (*in part*)
**Russell, Frederic A.** Salesmanship
**Russell, Henry Norris.** Stellar Constitution and Evolution
**Russell, Peter Edward.** Spain (*in part*)
**Russell-Clarke, Alan Daubeny.** Copyright (*in part*)
**Rutherford, Ernest, 1st Baron Rutherford.** Radioactivity, Natural (*in part*)
**Ryan, Edward A.,** S. J. Xavier, Francis
**Ryan, James Hugh,** S.T.D Parochial Schools
**Ryan, M. J.** Brehon Laws (*in part*)
**Ryden, George H.** Delaware (*in part*)
**Ryder, J. D.** Electronics in Industry
**Ryle, John Alfred,** M.D. Pain, Significance of

**Sabonadière, A.** Indian Law (*in part*)
**Sachs, Eleanor B.** Fan
**Sachs, John Harrison.** Anthraquinone (*in part*); Dyes, Synthetic
**Sacks, Captain John C.** Fur Farming
**Sadgrove, W. Howard.** Furniture Manufacture (*in part*); Upholstery (*in part*)
**Safford, Archibald.** Distress
**Safrastian, A.** Armenia; Asia Minor (*in part*); Kurdistan (*in part*); Mosul (vilayet) (*in part*)
**St. Cyres, Viscount (Stafford Henry Northcote).** Casuistry; Jansenism (*in part*)
**St. Helier, The Rt. Hon. Lord (Sir Francis Henry Jeune).** Divorce (*in part*)
**Saintsbury, George Edward Bateman.** Balzac, Honoré De; Gautier, Theophile; Mérimée, Prosper, Romance; Thiers, Louis Adolphe (*in part*)
**Salaman, Malcolm Charles.** Crayon; Glass Prints, Monotypes; Stipple and Crayon Engraving
**Salisbury, Sir Edward James.** Australia (*in part*)
**Salmon, Edward.** Banjermasin or Bandjarmasin (*in part*); Borneo (*in part*); Brunei (*in part*); Java (*in part*); [illegible] *part*); Malay Archipelago (*in part*), Sumatra (*in part*)
**Salmon, Rev. Stewart Dingwall Fordyce,** D.D. Logos (*in part*)
**Salter, Sir James Arthur.** Allied Maritime Transport Council, War Control of Shipping
**Salter, William Henry.** Psychical Research (*in part*)
**Saltonstall, Leverett.** Massachusetts (*in part*)
**Salvadori, Max W.** Farinacci, Roberto; Mussolini, Benito (*in part*)
**Salys, Anthony.** Balts, The (*in part*)
**Salzman, Louis Francis.** Aucassin and Nicolette; Bestiary, Minstrel
**Sampson, Ralph Allen.** Time Measurement (*in part*)
**Sams, Henry W.** Summer Schools (*in part*)
**Samuel, Bernard.** Philadelphia (*in part*)
**Samuels, Harry.** Labour Law (*in part*)
**Sanctis, Gaetano de.** Hannibal
**Sandeman, Lieutenant Brady.** World War II (*in part*)
**Sandys, Sir John Edwin.** Pausanias (*in part*)
**Sanford, Vera.** Ferrari, Lodovico; Hippocrates of Chios; Mathematical Notations
**Sanger, Charles Percy.** Russell, Bertrand Arthur William Russell, 3rd Earl (*in part*)
**Sanger, Ralph G.** Calculus, Differential and Integral (*in part*); Ellipse; Parabola; Paraboloid; Symmetric Functions
**Sanger, Sophy.** Labour Law (*in part*)
**Sankey, John, 1st Viscount of Moreton.** Criminal Appeal, Court of (*in part*)
**Sapir, Edward.** Central and North American Languages
**Sargent, John Garibaldi.** Attorney-General (*in part*)
**Sarton, George.** Hipparchus
**Sauer, Louis Wendlin,** M.D. Whooping Cough
**Saunders, Maurice.** Lithography (*in part*)
**Saurat, Denis** Drama (*in part*), French Literature (*in part*)
**Sauvageot, Aurelien.** Ural-Altaic Languages
**Savage, Harlow Dow.** Dry Quenching
**Savage, Howard James.** Athletic Sports (*in part*)
**Sawyer, Charles.** Government Departments (*in part*)
**Sawyer, Charles Baldwin.** Beryllium (*in part*)
**Sawyer, Wilbur Augustus,** M.D. Yellow Fever
**Saxton, W. T.** Gymnosperms (*in part*)
**Sayce, Rev. Archibald Henry,** D.D. Assur-Bani-Pal; Babylonia and Assyria (*in part*); Caria; Persepolis (*in part*), Sardanapalus, Sennacherib; Shalmaneser
**Sayce, R. U.** Cape Province (*in part*); Capetown (*in part*); Durban; Ermelo; Graaff Reinet (*in part*), Grahamstown (*in part*); Harrismith; Natal (*in part*); Orange Free State (*in part*); South Africa, Union of (*in part*); South-West Africa (*in part*), Transvaal (*in part*)
**Sayre, Daniel Clemens.** Accelerometer; Aileron; Aviation, Hazards of, Biplane; Gliding (*in part*); Le Bourget Airport
**Scammell, J. M.** Daras
**Scarborough, Dorothy.** Negro, The American (*in part*)
**Schade, James W.** Tyre (*in part*)
**Schaefer, Vincent Joseph.** Snow
**Schaeffer, George W.** Aqua Regia
**Schapera, I.** Africa (*in part*); Bushman Languages, Chiefs; Dual Organization; Gerontocracy; Herero; Hottentots (*in part*); Matabele
**Schapiro, J. Salwyn.** Anticlericalism
**Schelkunoff, Sergei A.** Electromagnetic Waves
**Schiller, Ferdinand Canning Scott.** Pragmatism
**Schilling, O. F. G.** Elliptic Functions (*in part*)
**Schlesinger, Kathleen.** Cittern; Crowd; Pianoforte (*in part*); Parsifal Bell Instrument
**Schley, Major General Julian Larcombe.** Mississippi River (*in part*)
**Schmidt, Carl Frederic,** M.D. Brain (*in part*)
**Schmidt, Karl Patterson.** Alligators; Amphisbaena; Argentine (*in part*); Asp; Axolotl; Basilisk; Batrachia, Black Snake; Bolivia (*in part*); Bullfrog; Caecilian (*in part*), Carnivora (*in part*); Cayman (or Caiman); Chile (*in part*); Colombia (*in part*); Crocodilian (*in part*); Cryptobranchus; Cuba (*in part*); Distribution of Animals (*in part*); Frog; Galápagos Islands (*in part*); Gavial; Hognose; Moccasin; Mugger; Newt; Python (*in part*), Pit Vipers; Rattlesnake; Salamander; Snakes (*in part*); Taxidermy (*in part*); Taxonomy; Tetrapoda; Toad; Tree-Frog; Turtle (*in part*), United States (of America), The (*in part*); Viper, Zoological Collecting (*in part*); Zoological Geography (*in part*); Zoological Societies
**Schmidt, Rev. P. Wilhelm,** D.Th. Numeral Systems
**Schmidt, Robert.** Glass (*in part*)
**Schmitt, Bernadotte Everly.** Hindenburg, Paul Von; Pan-Germanism; Rhineland, The; Versailles, Treaty of
**Schmitt, Waldo L.** Branchiopoda (*in part*); Cirripedia (*in part*); Copepoda (*in part*); Crab; Crayfish; Crustacea (*in part*); Hermit Crab; Lobster; Malacostraca (*in part*); Shrimp
**Schneider, Herbert Wallace.** Corporate State
**Schneirla, T. C.** Education in Animals; Psychology, Comparative
**Schoch, Thomas J.** Dextrin
**Scholefield, F.** Cloth Finishing
**Scholes, Percy Alfred.** Scriabin, Alexander Nicholaevich
**Scholes, Samuel Ray.** Bottle Manufacture (*in part*)
**Schomp, Albert L.** American Bank Note Company, The
**Schoth, Harry August.** Vetch
**Schott, Paul Gerhard.** Atlantic Ocean (*in part*)
**Schrenk, Helmuth H.** Chemistry (*in part*)
**Schulman, Sidney,** M.D. Paralysis

**Schultz, Edwin William,** M.D. Infantile Paralysis
**Schultze, Norman Clemens.** Amyl Acetate (*in part*); Butyl Acetates (*in part*); Glycols (*in part*)
**Schuman, Frederick Lewis.** Hitler, Adolf
**Schumpeter, Joseph Alois.** Capitalism
**Schürer, Emil.** Philo (*in part*)
**Schwartz, George Leopold.** Excess Profits Tax (*in part*)
**Scott, Rev. Charles Anderson,** D.D. Jesus Christ (*in part*); Ulfilas (*in part*)
**Scott, Franklin D.** Bergen; Charles XIV John; Denmark (*in part*); Frederick IX; Halden; Lithuania, Spitsbergen (*in part*), Vilnius
**Scott, George A. H.** Humane Societies
**Scott, Sir Henry Harold,** M.D. Sprue
**Scott, Hugh Arthur.** Concert; Extemporization, Lermontov, Tschaikovsky, Peter Ilich
**Scott, J. A.,** M.D. Medical Legislation (*in part*)
**Scott, John Waugh.** Neo-Hegelianism
**Scott, Rt. Hon. Sir Leslie (Frederic).** Factor (*in part*)
**Scott, Lester.** Basketball (*in part*)
**Scott, Malcolm K.** Lloyd's Register of Shipping
**Scrimgeour, John Stuart.** Betting Tax, Entertainments Duty; Increment Value Duty
**Scroggs, William Oscar.** Walker, William
**Scudder, Horace Elisha.** Lowell, James Russell; Stowe, Harriet Elizabeth
**Scullard, Howard Hayes.** Lepidus (*in part*); Sulpicius Rufus, Publius; Syria (*in part*); Telamon
**Seaborg, Glenn Theodore.** Actinium; Plutonium; Protactinium; Radioactivity, Artificial; Transuranium Elements, Uranium
**Seares, Frederick Hanley.** Photography, Celestial (*in part*)
**Sears, John Edward.** Metrology (*in part*)
**Sears, Ogle Hesse.** Soil (*in part*)
**Sears, Paul Bigelow.** Plants and Plant Science (*in part*)
**Seaver, Fred Jay.** Fungi (*in part*)
**Seccombe, Thomas.** Gilbert, Sir William Schwenk; Lever, Charles James (*in part*); Marlowe, Christopher (*in part*), Tichborne Claimant, The
**Sée, Henri Eugène.** Anne (of Brittany)
**Segrè, Emilio.** Astatine, Technetium
**Seibert, Florence Barbara.** Tuberculin
**Seignobos, Charles.** Europe (*in part*); Reform Movement (*in part*)
**Seitz, Frederick.** Solid State, Theory of
**Seligman, Charles Gabriel,** M.D. Africa (*in part*), Anthropology, Applied, Arabs, Azande, The; Baraabra Bari-Speaking Tribes, Beja (*in part*), Loatuko (*in part*); Nilotes, Nuba, The
**Seligman, Richard.** Aluminum Bronze; Duralumin
**Sellar, William Young.** Juvenal (Decimus Iunius Iuvenalis) (*in part*), Latin Literature (*in part*), Lucilius, Gaius (*in part*); Virgil (*in part*)
**Sellin, Thorsten.** Crime (*in part*)
**Sells, Dorothy M.** Trade Board (*in part*)
**Selwood, Pierce Wilson.** Magnetochemistry
**Sereni, Angelo Piero.** Moneta, Ernesto Teodoro
**Seth-Smith, David.** Aviary and Aviculture (*in part*)
**Seton-Watson, (George) Hugh Nicholas.** Yugoslavia (*in part*)
**Seton-Watson, Robert William.** Alexander I. Bosnia and Hercegovina, Croatia-Slavonia, Dalmatia (*in part*); Montenegro (*in part*); Peter I; Serbia (*in part*)
**Seton-Williams, M. V.** Arabia (*in part*)
**Setzler, Frank Maryl.** North America (*in part*)
**Severs, J. W.** Chicago, Milwaukee, St Paul and Pacific Railroad Company
**Seward, Ralph P.** Bleaching Powder; Halogens; Hydrochloric Acid and Hydrogen Chloride, Iodine
**Seymour, Charles.** Coolidge, Calvin; Harding, Warren Gamaliel, House, Edward Mandell; Lodge, Henry Cabot; Washington Conference; Wilson, Thomas Woodrow
**Shadwell, Arthur,** M.D. Plague (*in part*); Prostitution; Temperance (*in part*)
**Shaffer, Laurance F.** Adjustment (in Psychology)
**Shahan, Maurice Sommer.** Cattle (*in part*); Pig (*in part*); Sheep (*in part*)
**Shakespeare, W.** Singing
**Shakow, David.** [illegible]
**Shambaugh, George E.** [illegible] Ear, Nose and Throat, Diseases of the, Tonsillitis
**Shand, Alexander Faulkner.** Character
**Shands, Hazel Lee.** Oats; Rye
**Shannon, Fred. A.** Homestead and Exemption Laws
**Shantz, Homer LeRoy.** Physical Natural Resources (*in part*)
**Sharp, Aaron J.** Bryophyta (*in part*)
**Sharp, Robert Phillip.** Snow Line
**Sharp, William.** Thoreau, Henry David (*in part*)
**Shattock, Rev. E. A.** Morality, Primitive
**Shaughnessy, Howard John.** Immunity (*in part*)
**Shaw, Alan George Lewers.** Australia (*in part*)
**Shaw, Geoffrey William.** Poland (*in part*); Rumania (*in part*)
**Shaw, George Bernard.** Socialism Principles and Outlook
**Shaw, Herman.** Gravitation (*in part*)
**Shaw, James C.** Naval Strategy and Tactics; Staff, Naval (*in part*)
**Shaw, Wilfred Byron.** Michigan, University of (*in part*)
**Shearman, Hugh.** Banbridge; Belfast, Ireland, Northern; Lisburn; Neagh, Lough, Orangemen
**Shearman, Thomas Gaskell.** George, Henry
**Shebbeare, Rev. Charles John,** D.D. Atheism; Pantheism (*in part*), Trinity
**Shee, Sir George F.** Life-Boat and Life Saving (*in part*)
**Sheehan, John J.** Stock Exchange (*in part*)
**Sheehan, John P.** High-Speed Steel
**Shekerjian, Brigadier General Haig.** Chemical Warfare (*in part*)
**Shelley, A. N. C.** Government Departments (*in part*)
**Shepardson, Francis Wayland.** Fraternities, College
**Shepherd, Edwin Colston.** World War II (*in part*)
**Sheppard, Captain E. W.** Crimean War (*in part*), Frontier, Battles of The (*in part*)
**Sheppard, Samuel Edward.** Photochemistry
**Sheppard, William Fleetwood.** Interpolation; Probability and Error
**Sheringham, Hugh Tempest.** Angling (*in part*)
**Sherman, Mary S.,** M.D. Bone, Diseases and Injuries of
**Sherman, Orrin G.** Employee Representation (*in part*), Employee Stock Ownership (*in part*)
**Sherrill, M. H.** Sugar (*in part*)
**Sherrington, Charles Ely Rose.** Baghdad Railway, Channel Ferry, Railways (*in part*)
**Sherrington, Sir Charles Scott,** M.D. Brain (*in part*), Spinal Cord (*in part*); Sympathetic System
**Sherwell, Arthur.** Disinterested Management; "Gothenburg" Licensing System (*in part*); Licensed Victualler
**Sherwood, Frederick William.** Blackstone, Sir William
**Sheteliig, Haakon.** Norway (*in part*)
**Shidle, Norman G.** Motor Car (*in part*)
**Shields, Robert Hale.** California (*in part*)
**Shklovsky, I. W.** Andreyev, Leonid Nicolaievich
**Shoe. Lucy Taxis.** Astragal; Stoa
**Shotwell, James T.** Boniface, Saint, Golden Rose (*in part*); History (*in part*); Louis IX (*in part*)
**Showalter, Albert Kenneth.** Rainfall
**Showerman, Grant.** Attis or Atys, Syncretism
**Shreve, R. Norris.** Chemical Engineering
**Shull, A. Franklin.** Parthenogenesis; Photoperiodism (*in part*)
**Shultz, Birl E.** Bond (in Finance)
**Shute, David T.** Fire Escapes (*in part*)
**Sibree, Rev. James, D.D.** Madagascar (*in part*)
**Sidebotham, Herbert.** Fisher, John Arbuthnot Fisher, 1st Baron (*in part*)
**Sidgwick, Arthur.** [illegible]
**Sidgwick, Henry.** [illegible] of (*in part*)
**Sidgwick, Nevil Vincent.** Valence (*in part*)
**Siebel, Frederick Peter, Jr.** Beer (*in part*); Brewing (*in part*)
**Siebert, William Henry.** Hardware (*in part*)
**Siegbahn, Karl Manne Georg.** Spectroscopy, X-Ray (*in part*)
**Sikes, Edward Ernest.** Hera (*in part*)
**Silberschmidt, Max.** Zürich (*in part*)
**Silberstein, Ludwik.** Tensor [illegible] (*in part*)
**Silburn, Judith Ann.** Fats in Cookery, Fruit Cookery, Gravies, Meat Cookery
**Sillar, Frederick C.** War Graves (*in part*)
**Sillcox, Lewis Ketcham.** Locomotive (*in part*)
**Sillery, Anthony.** Bechuanaland; Kuruman; South-West Africa (*in part*)
**Sills, Kenneth Charles Morton.** Maine (*in part*)
**Sime, J.** Frederick II (*in part*)
**Simkin, Colin George Frederick.** British Commonwealth (*in part*)
**Simmons, E. C.** Dollar
**Simmons, George Finlay.** Albatross; Allen, Glover Morrill, Auks, Babbler; Barbet, Birds of Paradise, Bittern, Blackbird, Blackbird, Red-Winged, Blackcap, Blackcock, Bobwhite; Bowerbird, Brain-Fever Bird, Brambling; Budgerigar, Bufflehead; Bulbul; Bustard; Buzzard; Canary; Canvasback; Capercaillie, Cassowary, Chaffinch; Chapman, Frank Michler; Chickadee; Coly; Crane; Dodo; Drongo; Eagle; Eider; Emu or Emeu; Falcon, Finfoot; Flamingo; Flicker; Flower-Pecker, Flycatcher, Francolin, Frigate Bird, Frogmouth, Fulmar; Gadwell, Gallinule, Gannet, Garefowl, Garganey; Gnatcatcher, Godwit, Goldcrest or Golden Crested; Golden-Eye, Goldfinch, Grackle, Grebe, Greenfinch or Green Linnet; Grouse, Guinea Fowl; Gull, Hammerkop or Hammerhead, Harpy; Harrier, Hawk, Heath Hen, Hedge Sparrow; Hemipode, Heron; Honey Eater, Honey Guide, Hoopoe, Hornbill; Horned Owl; House Sparrow, Hummingbird, Jacamar; Jacana, Jaegar; Jay, Junco, Kea, Kestrel; Killdeer, Kingbird; Knot, Lammergeyer, [illegible] Loon; Lory, Macaw, Mer[illegible] Monal, Monaul; Motmot; [illegible] Woodcock
**Simmons, John F.** Precedence (*in part*)
**Simon, André L.** Bordeaux Wines; Graves, Wines of, Madeira Wines; Médoc Wines
**Simon, F.** Rathenau, Walther
**Simon, Jocelyn Edward Salis.** Divorce (*in part*)
**Simon, Marcel.** Alsace-Lorraine (*in part*)
**Simons, Harry.** Clothing Manufacture (*in part*); Worsted Manufacture
**Simonson, Lee.** Stage Design (*in part*)
**Simpson, Rev. Canon David Capell,** D.D. Achiacharus; Proverbs, Book of, Wisdom, Book of
**Simpson, George Gaylord.** Amblypoda; Ancylopoda or Chalicotherioidea; Anthracotherium; Arsinoitherium; Dinotherium, Dryopithecus, Eohippus, Ganodonta or Taemodonta; Hipparion; Hyracoidea, Litopterna; Mastodon; Multituberculata; Oreodont; Sivatherium, Tillodontia; Titanothere; Toxodontia
**Simpson, Percy.** Shakespeare, William (*in part*)
**Sinclair, Frazer V.** Cosmetics (*in part*)
**Sinclair, J. H.** Ecuador (*in part*)
**Singer, Charles,** M.D. Bacon, Francis (*in part*); Biology (*in part*); Constantine The African; Harvey, William (*in part*); Hippocrates and the Hippocratic Collection; Medicine, History of; Salerno (*in part*)
**Singsen, Antone G.** Insurance: Miscellaneous (*in part*)
**Sirén, Osvald.** Chinese Architecture; Chinese Sculpture

**Skeat, Walter William.** Layamon (*in part*)
**Skidmore, Louis.** Exhibition Architecture
**Skinner, Otis.** Make-Up
**Skoumal, Aloys.** Drama (*in part*)
**Slawson, Chester Baker.** Gem
**Slesser, Sir Henry.** Arbitration (*in part*); Privy Council, Judicial Committee of
**Sloan, Alfred Pritchard, Jr.** General Motors Corporation
**Sloane, William Milligan.** Bancroft, George
**Sloman, H. A.** Beryllium or Glucinum (*in part*)
**Slonimski, Antoni.** Drama (*in part*)
**Slonimsky, Nicolas.** Auric, Georges; Caruso, Enrico; Festivals, Music; Stoessel, Albert
**Slosson, Edwin Emery.** Edison, Thomas Alva
**Smail, Raymond Charles.** Adhemar de Monteil, Baldwin I (Emperor of Romania); Baldwin I (Count of Edessa) (*in part*); Baldwin II (Count of Edessa) (*in part*); Baldwin IV; Crusades (*in part*); Cyprus (*in part*); Fulk (King of Jerusalem) (*in part*); Raymund; Raymund III, Robert Guiscard (*in part*), St. John of Jerusalem, Knights of the Order of the Hospital of (*in part*)
**Small, Lyndon Frederick.** Bebeerine; Berberine; Cinchona Bark, Alkaloids of (*in part*); Narceine; Narcotine, Pilocarpine, Tropine
**Smart, William Marshall.** Orbit
**Smirnoff, Alexander.** Italian Wars; Russo-Turkish Wars
**Smith, Alexander Hardwick.** Stock Exchange (*in part*)
**Smith, Alfred Emanuel.** New York (State) (*in part*)
**Smith, A. Lorrain.** Lichens (*in part*)
**Smith, Arthur Hamilton.** Ring (*in part*)
**Smith, Austin E., M.D.** Sulfonal Group, The
**Smith, Bernard.** Permian; Triassic System or Trias
**Smith, Bruce.** Police
**Smith, Rev. B. T. D.** Matthew, St.; Matthew, Gospel of St.
**Smith, Cecil M.** Musical Comedy
**Smith, Clifford P., C.S.B.** Christian Science (*in part*); Eddy, Mary Baker
**Smith, David Clyde.** Mangel
**Smith, David Eugene.** Abacus; Algebra; Finger Numerals, Fraction, Gnomon; Numerals
**Smith, Denis Mack.** Italy (*in part*)
**Smith, Captain Eben E., M.D.** Medical Service, Navy (*in part*)
**Smith, Ernest Ellsworth, M.D.** Medical Jurisprudence (*in part*)
**Smith, F. D.** Saccharin
**Smith, G. E.** Chess (*in part*)
**Smith, George Gregory.** Ballad (*in part*); Barbour, John; Douglas, Gavin; Lyndsay, Sir David
**Smith, Gilbert Morgan.** Algae; Bacillariophyceae or Diatoms: Kelp
**Smith, Harry S.** Insect (*in part*)
**Smith, Hermon Dunlap.** Dearborn, Henry
**Smith, H. Grayson.** Liquefaction of Gases (*in part*)
**Smith, Homer W.** Excretion (Kidney)
**Smith, James Cruickshank.** Spenser, Edmund
**Smith, James Kellum.** American Academy in Rome, The
**Smith, J. D. Main.** Chromium (*in part*)
**Smith, John Alexander.** Croce, Benedetto
**Smith, Rev. John Frederick.** Schleiermacher, Friedrich Daniel Ernst (*in part*)
**Smith, John Merlin Powis.** Ecclesiastes (*in part*)
**Smith, Leo F.** Polytechnic (*in part*)
**Smith, Lybrand P.** Gunnery, Naval (*in part*)
**Smith, May.** Industrial Psychology
**Smith, Preserved.** Renaissance (*in part*)
**Smith, Raymond Stratton.** Soil (*in part*)
**Smith, Reginald Allender.** Archaeology (*in part*)
**Smith, Robert Ross.** World War II (*in part*)
**Smith, Robert Sidney.** Spain (*in part*)
**Smith, Sidney.** Babylonia and Assyria (*in part*); Calendar (*in part*), Chronology (*in part*)
**Smith, Sydney Bernard.** Aviation, Civil (*in part*)
**Smith, Thomas E.** Optics
**Smith, William A.** Printing (*in part*)
**Smith, William Benjamin.** Cone; Conic Section; Co-Ordinates (*in part*); Cylinder (*in part*)
**Smith, William Owen Lester.** Infant Schools; Parent Education (*in part*); School and Curriculum (*in part*); Summer Schools (*in part*); Vocational Training (*in part*)
**Smith, William Robertson.** Baal (*in part*); Chronicles, Books of (*in part*); David (*in part*); Decalogue (*in part*); Haggai (*in part*); Judges, The Book of (*in part*); Moloch (*in part*); Nabataeans (*in part*); Nazarite or Nazirite; Sabbath (*in part*)
**Smith, William Roy.** Compromise Measure of 1850, Missouri Compromise; Polk, James Knox
**Smithies, Frank.** Mathematical Societies and Periodicals
**Smith-Rose, Reginald Leslie.** Popov, Aleksandr Stefanovich
**Smogorzewski, Kazimierz Maciej.** Crimea (*in part*); Czechoslovakia (*in part*); Germany (*in part*); Poland (*in part*); Russia (*in part*), Switzerland (*in part*); World War II (*in part*); Yugoslavia (*in part*)
**Smoot, Reed.** Latter-Day Saints, Church of Jesus Christ of (*in part*)
**Smuts, Field Marshal Rt. Hon. Jan Christiaan.** Holism
**Smythe, A. R., F.R.C.V.S.** Swine Fever (*in part*)
**Smythe, Richard Haviland.** Shop Front Design (*in part*)
**Snedden, David.** Continuation Schools (*in part*)
**Snow, Chauncey Depew.** International Chamber of Commerce
**Snow, Henry Martin.** Wagons-Lits, Compagnie Internationale Des
**Snoxell, Frank Harvey.** Hydroplane; Motorboat
**Snyder, John W.** Government Departments (*in part*)
**Snyder, Morton.** Progressive Education Movement, The
**Snyder, Virgil.** Line Geometry
**Snyman, Jacobus Petrus Lodewicus.** South African Literature (*in part*)
**Soderberg, C. Richard.** Jet Propulsion
**Sokolnikoff, Ivan Stephen.** Vector Analysis (*in part*)
**Soles, Elmer M., O.D.** Optometry
**Sollenberger, Judith Katrina.** Easter; Independence Day, Thanksgiving Day
**Sollenberger, Paul.** Chronographs (*in part*)
**Solomon, Ezra.** Bonus
**Somervell, David Churchill.** Edward VIII (*in part*); Victoria
**Sommerich, Otto C.** Arbitration (*in part*)
**Sonneck, O. G.** Foster, Stephen Collins
**Sorley, William Ritchie.** Leibnitz or Leibniz, Gottfried Wilhelm (*in part*)
**Sorokin, Pitirim Alexandrovitch.** Aristocracy
**Sosman, Robert Browning.** Silica; Silicon
**Southwell, Sir Richard Vynne.** Materials, Strength of; Mechanics
**Sowerwine, Elbert Orla.** Anaconda Copper Mining Company
**Spaeth, John Duncan (Ernst).** Rowing (*in part*)
**Spaeth, Ralph, M.D.** Tetanus
**Spahr, Walter Earl.** Stockbroker (*in part*)
**Sparrow, John.** Forster, Edward Morgan; Housman, Alfred Edward
**Spate, Oskar Hermann Khristian.** Australia (*in part*)
**Speare, M. Edmund.** Coal and Coal Mining (*in part*)
**Speciael, Henri.** Société Internationale D'Énergie Hydro-Électrique
**Spector, Sidney.** Chief Justice; Court (*in part*)
**Spedding, Frank Harold.** Cerium; Dysprosium; Europium; Gadolinium, Lutecium; Praseodymium; Promethium, Rare Earths
**Spence, Howard.** Alum (*in part*)
**Spencer, Damon Alvin.** Sheep (*in part*)
**Spencer, Domina Eberle.** Photometry (*in part*)
**Spencer, Leonard James** Abrasives; Apatite; Apophyllite, Barite, Biotite, Boracite; Bornite, Bournonite; Brochantite; Brookite; Brucite, Chabazite; Chalcopyrite or Copper-Pyrites (*in part*); Chlorite; Covellite; Crocoite; Crystallography (*in part*); Cuprite; Dolomite, Epidote; Galena; Goniometer (*in part*); Graphite (*in part*); Hyacinth or Jacinth, Lapis Lazuli; Leucite; Mica (*in part*); Mineralogy (*in part*); Olivine; Parisite; Pollux or [illegible] (*in part*); Realgar; Rutile, [illegible] Staurolite (*in part*); Stibnite; Sylvite; Tetradymite Tetrahedrite (*in part*); [illegible]; [illegible] opaz; Tourmaline; Witherite; Wollastonite; Zeolites
**Spender, E. Harold.** Lloyd George, David (*in part*)
**Spender, J. Alfred.** English History (*in part*)
**Sperry, Elmer A.** Beacon (*in part*), Gyro-Compass or Gyroscopic Compass (*in part*); Gyroscope (*in part*)
**Spicer, George W.** County Court (*in part*)
**Spiegelman, Mortimer.** Birth Rate (*in part*); Death Rate (*in part*)
**Spielman, John Philip.** Copper (*in part*)
**Spielmann, Marion Harry (Alexander).** Gilbert, Sir Alfred, Pastel (*in part*); Repoussé; Roubiliac (Roubillac), Louis Francois; Shakespeare, William (*in part*)
**Spinka, Matthew.** Congregationalism (*in part*); Orthodox Eastern Church
**Spore, John B.** Tactics (*in part*)
**Sprague, Charles A.** Oregon
**Sprargen, William.** Welding
**Spratt, Hereward Philip.** Ship (*in part*)
**Springer, Burdell L.** Aeronautics, Aeroplane (*in part*); Helicopter
**Springer, George T.** Birling (*in part*)
**Springmeyer, J. E.** Nevada (*in part*)
**Sproul, Robert Gordon.** California, University of
**Sprout, Harold.** Atlantic, Command of The (*in part*)
**Sprout, Margaret (Tuttle).** Atlantic, Command of The (*in part*)
**Squire, William Barclay.** Byrd, William
**Stabell, Peter Platou.** Arbitration (*in part*)
**Stacey, Alfred E., Jr.** Air Co-ordination (*in part*)
**Stacey, Colonel Charles Perry.** Fenians
**Stach, Leo W.** Japan (*in part*)
**Stack, James Keane, M.D.** Sepsis; Wound
**Stainback, I. M.** Hawaii (*in part*); Honolulu (*in part*)
**Stamm, John Samuel, D.D.** Evangelical United Brethren Church, The
**Stamp, Josiah Charles Stamp, 1st Baron.** Building Societies (*in part*); Capital Levy (*in part*); Income: Economic Definition; Inheritance: Economic Aspects
**Stamp, Laurence Dudley.** Arakan; Bhamo (*in part*); Flysch; Irrawaddy, Miocene; Rural Depopulation (*in part*)
**Stancioff, Anna.** Ferdinand, Maximilian Karl Leopold Maria
**Staniar, William.** Belting For Power Transmission (*in part*); Power Transmission (*in part*)
**Stanislavsky, Constantine.** Theatre (*in part*)
**Stapleton, J. M.** Blast Furnace (*in part*)
**Starch, Daniel.** Advertising (*in part*)
**Stare, Frederick J., M.D.** Vitamins (*in part*)
**Starrett, Vincent.** Mystery Stories
**Starrett, William Aiken.** Structural Engineering (*in part*)
**Stauffer, Russell Scott.** Soil (*in part*)
**Stebbing, L. Susan.** Logistic
**Stebbings, Percy.** Credit, Insolvency or Bad Debt Insurance (*in part*); Life Insurance (*in part*); Motor Vehicle Insurance (*in part*)
**Stebbins, Joel.** Photometry (*in part*)
**Stecher, Paul George.** Xylene
**Stechow, Wolfgang.** Boy Jan Crayer, Gaspard de
**Steed, Henry Wickham.** Fabrizi, Nicola

**Steele, Roy W.** Indianapolis (*in part*)
**Stefansson, Vilhjalmur.** Arctic Regions (*in part*)
**Stein, C. D.,** V.M.D Anthrax
**Stein Leonard.** Zionism (*in part*)
**Steinman, David Barnard.** Bridges (*in part*); Carquinez Strait Bridge; Florianópolis Suspension Bridge
**Stenger, Vernon Arthur.** Bromine
**Stenning, John Frederick.** Bible (*in part*); Exodus, Book of; Leviticus; Targum
**Stenton, Doris Mary.** Frankpledge; Justiciar; Magna Carta; Pipe Rolls; Purveyance; Tallage
**Stenton, Sir Frank Merry.** Danelagh (*in part*); Dark Ages, Egypt (*in part*); English History (*in part*); Hide, Mark System; Normans (*in part*); Offa (king of Mercia); Poland (*in part*); Wessex (*in part*); Witan or Witenagemot
**Stephen, Sir Leslie.** Browning, Robert; Carlyle, Thomas (*in part*)
**Stephens, Henry Morse.** Mazarin, Jules (*in part*), Mirabeau, Honoré Gabriel Riqueti (*in part*)
**Stephenson, Nathaniel W.** Lincoln, Abraham
**Stephenson, R. J.** Physical Units (*in part*)
**Stephenson, Thomas Alan.** Anthozoa, Coelenterata, Ctenophora; Graptolites, Hydrozoa; Scyphozoa
**Stern, Ben M.** Aviation, Civil (*in part*)
**Stern, Kurt G.** Protoplasm (*in part*)
**Stevens, Ashton.** Banjo
**Stevens, Courtney Edward.** Germany (*in part*)
**Stevens, Wayne Edson.** New Hampshire (*in part*)
**Stevenson, Adlai E.** Illinois (*in part*)
**Stevenson, E.** Nursery Schools (*in part*)
**Stevenson, Frederick J.** Potato (*in part*)
**Stevenson, George,** M.D. [illegible] (*in part*)
**Stevenson, Robert Louis.** Béranger, Pierre Jean de (*in part*)
**Steward, F. C.** Inulin
**Steward, Julian H.** South America (*in part*)
**Stewart, C. L.** Allotments (*in part*); Agricultural Economics (*in part*); Agricultural Insurance; Farm Valuations
**Stewart, Thomas Dale,** M.D. Craniometry
**Steyermark, [illegible].** Argentina (*in part*); Chile (*in part*) (*in part*)
**Stibitz, Geo[illegible].** Mathematical Instruments
**Stieglitz, Edward J.,** M D. Gerontology and Geriatrics
**Still, Sir George Frederic,** M.D. Children's Diet
**Stillman, Paul Roscoe,** D.D.S. Pyorrhoea (*in part*)
**Stimson, Henry Lewis.** London Naval Conference, 1930, The (*in part*)
**Stine, Oscar Clemen.** Agricultural Statistics (*in part*)
**Stitt, Commander George Marquis Stewart.** Dockyards and Naval Bases (*in part*)
**Stockder, Archibald Herbert.** Stock
**Stoddart, Alexander.** Poster (*in part*)
**Stoessel, Albert.** Choral Singing (*in part*)
**Stokes, Charles Anderson.** Carbon Black
**Stokes, Henry Gordon.** Newcastle-under-Lyme
**Stone, Doris Zemurray.** Lenca
**Stone, Eric.** Becket, Thomas (à); Bayeux Tapestry, The (*in part*); Hereward
**Stone, Herbert Lawrence.** House Boat; Yachting (*in part*)
**Stone, Robert Granville.** Aerology, Aerologist; Air Mass; Drizzle; Fog; Haze; Horse Latitudes; Indian Summer; Mist; Rime; Shaw, Sir Napier; Sleet; Soft Hail; Synoptic Charts; Tornado; Waterspout
**Storch, Henry H.** Hydrogenation
**Stormont, Major W.** Lloyd Trestin Line (*in part*)
**Storr, Francis.** Duel (*in part*); Games, Classical
**Story, Isabelle F.** National Park System (*in part*)
**Stott, Verney.** Density; Hydrometers (*in part*)
**Stout, George Leslie.** Paintings, Conservation of
**Strahan, James Andrew.** Bill of Sale (*in part*); Equity, Executors and Administrators (*in part*); Foreclosure (*in part*); Intestacy (*in part*); Will or Testament (*in part*)
**Stranathan, James Docking.** Gamma Rays; Radiation Rays (*in part*)
**Strange, Lieutenant Colonel Edward Fairbrother.** Della Quercia or Della Fonte Jacopo; Enamel (*in part*); Hiroshige; Hokusai Katsushuka; Kyōsai, Sho-Fu, Lacquer (*in part*); Utamaro
**Stratton, Samuel Wesley.** Massachusetts Institute of Technology, The
**Straumann, Heinrich.** Swiss Literature (*in part*)
**Straus, H. L.** Totalizator
**Strawn, Silas H.** American Bar Association
**Streat, Sir Edward Raymond.** Cotton Board, British
**Strehlow, Theodor George H.** Australian Languages
**Strickland, Gerald, 1st Baron Strickland.** Malta (*in part*)
**Stripe, Carl.** Steam Generation (*in part*)
**Strock, Clifford.** Heating and Ventilation
**Stromberg, Austin.** Motor Transport, Commercial (*in part*)
**Stromberg, Edward Helmer.** Northwestern University
**Strong, Donald Stuart.** Poll Tax (*in part*)
**Strong, Eugenie.** Roman Art (*in part*)
**Struve, Otto.** Spectroscopy. Astronomical
**Stuart, H. C.** Importing In Practice (*in part*)
**Stuart-Jones, Sir Henry.** Caesar, Gaius Julius; Constantine; Roman Art (*in part*). Rome (*in part*)
**Stulman, Fo[illegible].** Radio Finders (*in part*)
**Sturt, Henry.** [illegible], Étienne Bonnot de; Metempsychosis (*in part*), Nominalism
**Sullivan, Harris Martin.** Vacuum (*in part*)
**Sumner, Francis B.** Colours of Animals (*in part*)
**Sutcliffe, Ronald.** Brandy (*in part*); Potato Spirit (*in part*); Spirits
**Sutherland, Charles Humphrey Vivian.** Spain (*in part*)
**Sutherland, Lucy Stuart.** English History (*in part*); Ostend Company
**Sverdrup, Harald Ulrik.** Atlantic Ocean (*in part*); Atlantic, Command of the (*in part*); Indian Ocean (*in part*), Ocean and Oceanography (*in part*); Pacific Ocean (*in part*); Southern Ocean
**Swann, William Francis Gray.** Photography, Celestial (*in part*)
**Swanson, Ernst W.** Cassel, Gustav
**Swanson, Gustav A.** Bird Sanctuaries
**Swaythling, Samuel Montagu, 1st Baron.** Arbitrage (*in part*)
**Sweeney, John F., S.J.** Atonement
**Sweet, Frederick A.** Art Sales
**Sweet, Henry.** Grimm, Jacob Ludwig Carl (*in part*)
**Sweet, William Warren,** D.D. Methodism; Revival, Religious
**Swift, Ernest Haywood.** Chemistry (*in part*)
**Swift, Gustavus Franklin.** Swift & Company
**Swinburne, Algernon Charles.** Beaumont and Fletcher (*in part*); Marlowe, Christopher (*in part*); Mary Queen of Scots (*in part*)
**Swire, Joseph.** Albania (*in part*); Machado, Bernadino (*in part*); Makonnen, Ras Tafari; William (Prince of Wied); Zog I
**Sykes, Brigadier General Sir Percy Molesworth.** Persia (*in part*); Persia, Campaigns in
**Sykes, William Stanley,** M.D. Acetylene in Medicine
**Symington, W. Stuart.** Government Departments (*in part*)
**Symonds, John Addington.** Machiavelli, Niccolo; Petrarch (*in part*); Poggio (*in part*); Politian (*in part*); Renaissance, The (*in part*); Tasso, Torquato (*in part*)
**Symons, Arthur.** Goncourt, de (*in part*); Leconte de Lisle, Charles Marie René; Mallarmé, Stephane; Verlaine, Paul, Villiers de L'Isle-Adam, Philippe Auguste Mathias, Comte de
**Szeftel, Marc.** Straits Question, The
**Szilagyi, L. F.** Siemens (*in part*)

**Tabor, Milton** Kansas (*in part*)
**Tabor, Richard John.** Fungi (*in part*)
**Taft, Lorado.** Saint-Gaudens, Augustus
**Taft, Philip.** Strikes and Lockouts (*in part*)
**Tait, David.** Konkomba
**Tait, Peter Guthrie.** Maxwell, James Clerk
**Tait, Thomas Smith.** Russian Architecture (*in part*)
**Talbot, Francis Xavier, S.J.** Jesuits, Society of
**Taliaferro, William H.** Dentistry
**Tallents, Sir Stephen George.** Empire Marketing Board (*in part*)
**Tamagna, Frank M.** Japan, Bank of (*in part*); Yen
**Tanner, Fred Wilbur.** Yeast
**Tanner, Joseph Robson.** Pepys, Samuel (*in part*)
**Tansill, Charles Callan.** Albany Congress, Annapolis Convention
**Tapp, Harry F.** Oil Heating, Domestic
**Tarshis, Lorie.** Factors of Production
**Tate, Francis G. H.** Brandy (*in part*); Gin (*in part*), Potato Spirit (*in part*); Poteen; Whisky or Whiskey (*in part*)
**Tate, William Edward.** Hotel (*in part*)
**Tattersall, Creassey Edward Cecil.** Rugs and Carpets (*in part*)
**Tatum, Arthur Lawrie,** M.D Barbituric Acid and Barbiturates
**Taube, Henry.** Antimony; Arsenic; Bismuth; Hydrogen Peroxide
**Taunton, Ethelred.** Cullen, Paul; Fisher, John
**Taussig, Frank William.** Tariffs (*in part*)
**Taylor, Alan John Percivale.** Austria (*in part*); Austria, Empire of (*in part*); Bethlen, Stephen (István), Count; Bismarck, Otto, Germany (*in part*), Prussia (*in part*)
**Taylor, Alfred Edward.** Plato; Socrates
**Taylor, Alonzo Englebert,** M.D. Food Supply of the World (*in part*)
**Taylor, Alrutheus Ambush.** Fisk University (*in part*)
**Taylor, Anne Dewees** (Mrs Henry C. Taylor). Agronomy; Espalier
**Taylor, Basil.** Schools of Art (*in part*)
**Taylor, Charles Carlisle.** Mahan, Alfred Thayer
**Taylor, Deems.** Zither
**Taylor, Donald F.** Columbium (*in part*)
**Taylor, Galen M.** Sights
**Taylor, Griffith.** Alberta (*in part*); Australia (*in part*); British Columbia (*in part*); Canada (*in part*); Labrador (*in part*); Manitoba (*in part*); New Brunswick (*in part*); Newfoundland (*in part*); New South Wales (*in part*); Northwest Territories (*in part*); Quebec (*in part*) (*in part*)
**Taylor, Harold** [illegible] Farming (*in part*)
**Taylor, Joshua, C.** Taft, Lorado; Terra Cotta (*in part*)
**Taylor, Lloyd William.** Telephone (*in part*)
**Taylor, Norman.** Azalea; Chrysanthemum (*in part*); Cinchona; Cyclamen; Iris; Lilac or Pipe Tree; Magnolia, Orchids (*in part*); Pansy; Passion-Flower (*in part*); Poppy (*in part*), Rhododendron (*in part*); Rose (*in part*); Saxifrage
**Taylor, R.** Pressure Chemistry
**Taylor, Richard.** Cartoon (*in part*)
**Taylor, Sir Thomas Weston Johns.** Azo Compounds; Benzidine (*in part*); Diazo Compounds; Fulminic Acid, Guanidine; Hydrozoic Acid; Oximes; Pyridine; Quinoline
**Tead, Ordway.** Leadership
**Tefft, Sheldon.** Laws of Real Property and Conveyancing (*in part*); Will or Testament (*in part*)
**Telford, Rev. John.** Wesley (family); Wesley, John
**Teller, Edward.** Nucleus (*in part*)
**Templeman, Geoffrey.** English History (*in part*)
**Tennant, Frederick Robert,** D.D. Agnosticism;

Deism; Faith, Sin; Theology
**Tenney, Robert I.** Malt (*in part*)
**Tennyson, Sir Charles Bruce Locker.** Dumping
**Tether, C. Gordon.** Gulden
**Tetlow, Henry.** Cosmetics (*in part*)
**Thacker, Carlisle Monroe.** Carbon Disulphide
**Thalbitzer, William.** Eskimo Language
**Thatcher, Edward.** Carving Tools
**Thatcher, Rev. Griffiths Wheeler, B.D.** Abulfaraj; Arabia (*in part*), Arabian Philosophy (*in part*); Ash 'Ari; Hassān ibn Thābit; Hishām ibn al-Kalbī (*in part*); Ibn Faradī; Ibn Fārid, Jāhiz, Jurjānī, Nābigha Dhubyáni, Waqidi; Ya'qūbi, Zuhair
**Thayer, Philip W.** High Seas
**Thaysen, A. C.** Bacteriology in Industry
**Theisen, Earl.** Motion Pictures (*in part*)
**Thibaudet, Albert.** Bainville, Jacques, Barrès, Maurice, Bergson, Henri
**Thiel, George Alfred.** Marl
**Thirsk, Irene Joan.** Corn Laws (*in part*)
**Thomas, Charles Lamar.** Catalysis (*in part*)
**Thomas, David Christopher Traherne.** Butterfield, William; Detaille, (Jean Baptiste) Edouard; Dyce, William; Maillol, Aristide Joseph Bonaventure; Sickert, Walter Richard, Stevens, Alfred, Stevens, Alfred George; Whistler, James Abbott McNeil
**Thomas, Edward J.** Abhidhamma; Ananda; Barlaam and Josaphat, Buddha and Buddhism; Jātaka, Lamaism; Lumbinī; Mahayāna; Maitreya, Pahlavi (*in part*); Zend-Avesta (*in part*)
**Thomas, Elbert Duncan.** Utah (*in part*)
**Thomas, Frederick William.** Indian Literature
**Thomas, Henry.** Bookbinding (*in part*)
**Thomas, Northcote Whitbridge.** Automatism; Faith Healing
**Thomas, Prentice M.** Cotton and the Cotton Industry (*in part*)
**Thomas, Robert S.** Insignia, Military
**Thomas, W. Cave.** Encaustic Painting
**Thomas, William.** Adsorption
**Thompson, A. Hamilton.** Chapel, Church (*in part*)
**Thompson, Carl Dean.** Municipal Trading (*in part*)
**Thompson, Sir D'Arcy Wentworth.** Fur-Seals
**Thompson, Sir Edward Maunde.** Autographs; Diplomatic (*in part*); Papyrus; Parchment
**Thompson, George Henry Main.** Laws Relating to Seamen (*in part*)
**Thompson, Huston.** Federal Trade Commission, The
**Thompson, James Matthew.** France (*in part*)
**Thompson, John Spencer.** Life Insurance (*in part*)
**Thompson, Reuben R.** Cigar
**Thompson, Silvanus Phillips, M.D.** Compass (*in part*)
**Thompson, Virginia.** Indo-China, French (*in part*); Siam (*in part*)
**Thompson, Wallace.** Blaine, James Gillespie; Bolivar, Simon; Caribbean Sea; Colón (*in part*), Flores (*in part*); Fonseca Bay, or Gulf of, Guatemala, Nueva Guatemala or New Guatemala (*in part*); Havana (*in part*); León (*in part*); Miskito Coast (*in part*); Panamá (capital) (*in part*)
**Thomson, Sir Basil (Home).** Crime (*in part*); Frauds (*in part*)
**Thomson, David.** Chatham, William Pitt, 1st Earl of, France (*in part*); Pétain, Henri Philippe Benoni Omer Joseph; Sedan (France) (*in part*); Windham, William; Yorke, Charles
**Thomson, Derick Smith.** Scottish Literature (*in part*)
**Thomson, George Pirie.** Censorship (*in part*)
**Thomson, Harry C.** Ordnance (*in part*)
**Thomson, Sir John Arthur.** Biology, Economic (*in part*); Birds (*in part*); Education in Animals; Evolutionary Ethics, Locomotion of Animals (*in part*); Naturalization of Plants and Animals; Parasitism, Symbiosis
**Thomson, Leonard Monteath.** South Africa, Union of (*in part*)
**Thomson, Philip Livingston.** Audit Bureau of Circulations
**Thomson, Procter.** Excise Tax
**Thomson, T. N.** Sanitation of Buildings (*in part*)
**Thorndike, Robert L.** Thorndike, Edward Lee
**Thorne, Wendell E.** Capital, Export of
**Thornthwaite, Charles Warren.** Drought
**Thornton, John L.** Medical and Surgical Societies (*in part*)
**Thorpe, William Homan.** Smell and Taste (*in part*)
**Thorson, Alfred T.** Life-Boat and Life Saving (*in part*)
**Thum, Ernest Edgar.** Iron and Steel, Manganese Steel, Presses and Presswork; Steels, Alloy; Tool Steel; Tungsten Steel; Vanadium Steel
**Thursfield, Sir James Richard.** Parnell, Charles Stewart (*in part*)
**Tibble, John William.** Free Verse
**Tiegs, O. W.** Millipede; Myriapoda; Pauropoda; Symphyla
**Tiele, P. A.** Dantu, Christophe
**Tigert, John James.** Mann, Horace
**Tilden, William Tatem, Jr.** Lawn Tennis and Tennis (*in part*)
**Tildesley, Miriam Louise.** Dead, Disposal of the (*in part*)
**Till, T. Marston.** Brush (*in part*)
**Tilley, Cecil Edgar.** Amphibole; Amphibolite; Anorthoclase, Augite; Basalt; Batholith; Borolanite, Charnockite; Cordierite; Dumortierite; Eclogite; Enstatite; Epidiorite; Felspar or Feldspar; Garnet; Gneiss; Granite; Hornfels; Ijolite, Kyanite; Labradorite (*in part*); Leucite Rocks; Metamorphism; Metasomatism; Mica-Schist; Microcline, Monzonite; Moonstone; Mullite; Napoleonite; New Zealand (*in part*), Orthoclase; Ottrelite; Petrology; Picrite; Plagioclase; Prehnite; Pyroxene; Scapolite (*in part*); Schorl; Serpentine; Sillimanite; Spilite; Spinel; Syenite, Tachylyte or Tachylite; Tektite, Theralite; Tremolite; Variolite; Zoisite
**Tillyard, Henry Julius Wetenhall.** Byzantine Music
**Timasheff, Nicholas S.** Stammler, Rudolph
**Tipping, Avray.** Interior Decoration (*in part*)
**Tippo, Oswald.** Plants and Plant Science (*in part*)
**Tirtoff-Erté, Romain de.** Dress (*in part*)
**Tisdale, Harry Robert.** Archil
**Tizard, Sir Henry Thomas.** Thermochemistry
**Tobey, James Alner.** Bread (*in part*); Flour and Flour Manufacture (*in part*); Food Preservation (*in part*)
**Tobin, Maurice J.** Government Departments (*in part*)
**Tod, Marcus Niebuhr.** Archidamus; Cleomenes; Demaratus; Leonidas (*in part*), Lysander; Pausanias; Pylos (*in part*), Sparta
**Todd, Frederick Porter.** Training Corps, Officers' (*in part*); Uniforms (*in part*)
**Todd, John Aiton.** Cotton Famine, 1861-1865 (*in part*)
**Tolles, Frederick B.** Friends, Society of (*in part*)
**Tolnai, V.** Hungarian Language
**Tomita, Kojiro.** Art (*in part*); Screen (*in part*)
**Tonks, Henry.** Pastel (*in part*)
**Topalian, Sarkis.** Armenian Literature (*in part*)
**Torrey, Charles Cutler, D.D.** Ahasuerus; Daniel (*in part*); Esther (*in part*); Ezra; Ezra, Third Book of, Ezra and Nehemiah, Books of; Nethinim
**Tout, Thomas Frederick.** Edward I; Edward II; Edward III; Edward, "The Black Prince"
**Tovey, Sir Donald Francis.** Aria; Bach, Johann Sebastian (*in part*); Beethoven, Ludwig Van; Boccherini, Luigi, Bruckner, Anton (*in part*); Cantata, Chamber Music; Cherubini Maria Luigi Carlo Zenobia Salvatore, Chorale; Concerto; Contrapuntal Forms; Counterpoint; Couperin, François; Dvořák, Anton (*in part*); Fugue; Gluck, Christoph Willibald; Handel, George Frederick (*in part*); Harmony; Instrumentation, Lasso (Lassus) Orlando, Madrigal; Melody; Mendelssohn-Bartholdy, Jakob Ludwig Felix, Monteverdi or Monteverde, Claudio; Motet; Mozart, Wolfgang Amadeus; Music (*in part*); Oratorio; Overture, Palestrina, Giovanni Pierluigi da, Programme Music, Rhythm (*in part*), Scherzo; Sonata; Sonata Forms, Suite; Symphonic Poem, Symphony; Variations, Victoria (or Vittoria), Tommasso Ludovico da, Wagner, Wilhelm Richard (*in part*)
**Tovey, Rev. Duncan Crookes.** Gray, Thomas (*in part*); Thomson, James (*in part*)
**Tower, James A.** Transjordan (*in part*)
**Tower, Walter S.** Iron and Steel (*in part*)
**Towner, Horace Mann.** Aguadilla (*in part*); Arecibo; Guayama; Manati (*in part*); Mayaguez (*in part*), Ponce (*in part*), Porto Rico or Puerto Rico (*in part*); San Juan (*in part*)
**Townshend, Bailey.** Tabulating Machines
**Toy, Crawford Howell.** Ecclesiastes (*in part*)
**Toynbee, Arnold Joseph.** Mustafa Kemal Ataturk (*in part*)
**Tracey, C. B.** Berber
**Trager, George L.** Language
**Transehe, Nicolas A.** Tierra Del Fuego
**Trask, Parker Davies.** Sapropel; Shale, Oil
**Travers, Morris William.** Liquefaction of Gases (*in part*)
**Trent, William Peterfield.** Lanier, Sidney
**Trinterud, L. J.** Presbyterian; Reformed Churches, The
**Tripp, Sir (Herbert) Alker.** Traffic and Traffic Regulation (*in part*)
**Tripp, L. Reed.** Minimum Wage (*in part*)
**Tritton, Arthur Stanley.** Sabaeans
**Troland, Girard B.** Light Railways, Military (*in part*)
**Trotsky, Lev.** Lenin, Vladimir Ilyich Ulyanov (*in part*)
**Trotter, Mildred.** Skin and Exoskeleton
**Trubetzkoy, Prince N. S.** Caucasian Languages
**Truesdell, Leon E.** Census (*in part*); North America (*in part*), Rural Depopulation (*in part*); United States (of America), The (*in part*); Urbanization.
**Truman, Ethel.** Flammarion, Nicolas Camille (*in part*); Lorentz, Hendrik Antoon
**Trumbull, Harlan L.** Rubber: Production and Manufacture
**Trumpler, Robert Julius.** Absorption of Light in Space; Eclipse (*in part*); Star Cluster
**Tryon, R. M.** Bracken
**Tseng, Cheng Kwei.** Agar
**Tucker, Ray.** Democratic Party; Progressive Party, U.S. (*in part*); Truman, Harry S.
**Tuft, Louis, M.D.** Asthma; Hay Fever
**Tukey, Harold Bradford.** Horticulture
**Tulin, Leon Arthur.** Riot (*in part*)
**Tunis, John R.** Bowls (*in part*); Lawn Tennis and Tennis (*in part*)
**Tunnicliffe, H. E.** Hormones
**Tunstall, William Cuthbert Brian.** The Armada (*in part*); Chiogga (*in part*), Dutch Wars (*in part*); Grand Alliance, War of The (*in part*); La Hogue, Battle of (*in part*); Navarino, Battle of (*in part*), Quiberon, Campaign and Battle of (*in part*), Seven Years' War (*in part*); Spanish Succession, War Of The (*in part*)
**Turing, Harvey Doria.** Angling (*in part*)
**Turner, Cuthbert Hamilton.** Bible (*in part*)
**Turner, E. Raymond.** Star Chamber
**Turner, Frederick Jackson.** United States (of America), The (*in part*)
**Turner, George James.** Clarendon, Constitutions of; County; Hundred; North Hampton, Assize of
**Turner, Sir George W.** Munitions, Ministry of
**Turner, Howard A.** Farm Rents (*in part*)
**Turner, Laurence A.** Wood-Carving (*in part*)
**Turner, Ralph Lilley.** Pali Language and Literature (*in part*); Romany Language; Sanskrit Language and Literature (*in part*)
**Turville-Petre, Gabriel.** Hallgrímsson, Jonas;

Icelandic Literature (*in part*); Saga
**Tuthill, Edward.** Kentucky (*in part*)
**Tuttle, Charles H.** Insanity in Law (*in part*)
**Tuttle, Worth.** Bierce, Ambrose; Dickinson, Emily
**Tweedie, Michael Willmer Forbes.** Malaya (*in part*)
**Tweedy, Owen Meredith.** Cairo (*in part*)
**Twenhofel, William H.** Septaria; Silurian System
**Twentyman, A. E.** Education, History of (*in part*); University Colleges
**Twiss, Sir Travers.** Sea Laws (*in part*)
**Twitty, Victor Chandler.** Vertebrate Embryology (*in part*)
**Twombly, Neil J.,** S J. Thomas, St.
**Twyman, Frank.** Lens
**Tyler, Albert.** Parthenogenesis, Artificial
**Tyler, A. Range.** [illegible] (*in part*)
**Tyler, Royall.** Byzantine Art (*in part*)
**Tylor, Sir Edward Burnett.** Ordeal (*in part*)
**Tyson, B. A.** Fisheries, Law of (*in part*)

**Ukers, William H.** Tea
**Underhay, F. G.** Patents (*in part*)
**Underhill, Evelyn (Mrs. Stuart Moore).** Mysticism (*in part*)
**Underwood, Norman.** Carbon Paper
**Untermeyer, Louis.** Poetry (*in part*)
**Updegraff, Ruth.** Nursery Schools (*in part*)
**Urban, Joseph.** Theatre (*in part*)
**Urban, Wilbur Marshall.** Value, Theory of
**Urey, Harold Clayton.** Deuterium and Tritium
**Urwick, Lieutenant Colonel Lyndall.** Scientific Management (*in part*)
**Usborne, Vice-Admiral Cecil Vivian.** World War II (*in part*)

**Vaeth, Joseph Gordon.** Airship; Airship Sheds
**Vagts, Alfred.** Conscription (*in part*)
**Vallarta, Manuel Sandoval.** Gravitation (*in part*)
**Van Brunt, John.** Steam Generation (*in part*)
**Van Buren, Albert William.** Italy (*in part*); Sicily (*in part*)
**Vance, Lee J.** Soda Fountain
**Van Cleave, Harley Jones.** Acanthocephala; Kinorhyncha
**Van Cleef, Eugene.** Transport (*in part*)
**Vandervelde, Emile.** International, The (*in part*)
**Vandewalker, Nina C.** Kindergarten (*in part*)
**Vandiver, H. S.** Diophantine Equations; Fermat's Last Theorem
**Van Dyke, Henry,** D.D. Emerson, Ralph Waldo
**Van Dyke, John Charles.** Inness, George
**Van Gelder, H. E.** Glass (*in part*), Pottery and Porcelain (*in part*)
**Van Tyne, Claude Halstead.** American Revolution, The (*in part*)
**Van Urk, J. Blan.** Hunting
**Van Vleck, E. Burr.** Conformal Representation
**Van Vleck, J. H.** Dirac, Paul Adrien Maurice; Quantum Mechanics; Uncertainty Principle; Wave Mechanics
**Van Waters, Miriam.** Children's Courts or Juvenile Courts (*in part*)
**Van Winkle, Walton, Jr.** Adulteration
**Vaughan, Herbert Millingchamp.** James (James Francis Edward Stuart)
**Veale, Douglas.** Oxford University (*in part*)
**Veblen, Oswald.** Differential Forms (*in part*); Projection, in Mathematics; Projective Geometry
**Veen, Adriaan van der.** Drama (*in part*); Dutch Literature (*in part*)
**Vennesland, Birgit.** Biochemistry; Enzymes; Glutathione
**Vernon-Harcourt, Leveson Francis.** River and River Engineering (*in part*)
**Vernon-Harcourt, L. W.** Lord High Steward
**Vesey-Fitzgerald, Brian Seymour.** Gypsies (*in part*)
**Viall, Ethan.** Thermit
**Viard, Jules.** Jacquerie, The
**Vidalenche, Gérard.** Stock Exchange (*in part*)
**Viles, Jonas.** Missouri (*in part*)
**Villard, Henry Serrano.** Liberia (*in part*)
**Villari, Luigi.** Bentivoglio, Giovanni, Borgia, Cesare, Carbonari, Cavour, Camillo Benso, Fanti, Manfredo (*in part*), Florence (*in part*), Frederick III, Italian Front, In the World War, 1914–1918, Mazzini, Giuseppe (*in part*); Naples, Kingdom of (*in part*); Pisa (*in part*), Rimini (*in part*), Savonarola, Girolamo (*in part*); Savoy, House of; Tuscany (*in part*), Victor Emmanuel II, Victor Emmanuel III (*in part*)
**Villari, Pasquale.** Florence (*in part*); Medici (*in part*), Pisa (*in part*), Rimini (*in part*), Savonarola, Girolamo (*in part*)
**Vincent, Melvin J.** Los Angeles (*in part*)
**Viney, Kenneth R.** News Agency (*in part*)
**Vinogradoff, Sir Paul.** Anglo-Saxon Law (*in part*); Folkland; Jurisprudence, Comparative (*in part*), Law of Succession, Manor (*in part*), Serfdom (*in part*), Socage, Village Communities; Villeinage
**Viot, Pierre.** Civil Service (*in part*)
**Visser, Hein Cornelis.** Arbitration (*in part*)
**Vivian, A. C.** Beryllium or Glucinum (*in part*)
**Vivian, Sir Sylvanus (Percival).** Campion, Thomas; Census (*in part*)
**Vlekke, Bernard H. M.** Indonesia
**Vocadlo, Otakar.** Czech Language and Literature (*in part*)
**Vogt, Evon Z.** Mexico
**Vogt, Richard Rockhill.** Acetylene
**Volkmann, Ernest W.** Benzene, Phenol
**Vollmer, August.** Investigation, Criminal (*in part*)
**Voronoff, Serge,** M.D Rejuvenation
**Vowles, Hugh P.** Briquetting (*in part*)

**Waage, F. O.** Mosaic
**Wace, Alan John Bayard.** Aegean Civilization (*in part*); Athens (*in part*); Greek Archaeology
**Waddell, Laurence Austine.** Lhasa (*in part*)
**Wade, Mrs. E. K.** Girl Guides (*in part*)
**Wade-Evans, Rev. Arthur Wade.** Welsh Laws or Leges Britanniae
**Waesche, Russell Randolph.** Coast Guard (*in part*), Lighthouses (*in part*)
**Wagenknecht, Edward.** Novel (*in part*)
**Waite, John Barker.** Larceny (*in part*)
**Wakefield, Ralph V.** Blasting (*in part*)
**Wakerlin, George Earle.** Blood Pressure
**Walaszek, E. J.** Morphine (*in part*)
**Walch, Jan.** Dutch Literature (*in part*)
**Walford, Lionel Albert.** Pilchard or Sardine; Tuna
**Walker, Captain A. H.** Paravane, The
**Walker, D. L.** Federation of British Industries
**Walker, Edmund Murton.** Canada (*in part*)
**Walker, Rev. Edward Mewburn.** Greece (*in part*); Theopompus; Xenophon
**Walker, Egbert H.** Asia (*in part*)
**Walker, Sir Gilbert Thomas.** Flight, Natural
**Walker, Harvey.** Administrative Commission
**Walker, Hubert.** Fire Engines (*in part*)
**Walker, J. Frederic.** Formaldehyde
**Walker, James.** Ground Rent (*in part*); Intestacy (*in part*); Sheriff or Shire-Reeve
**Walker, Ralph Thomas.** Ornament, Architectural
**Walker, Williston,** D D. Bacon, Leonard; Cotton, John; Hopkins, Samuel
**Wall, Bernard.** Pius XII; Sturzo, Luigi
**Wall, Hubert Stanley.** Continued Fractions; Infinite Products
**Wallace, David Duncan.** Laurens, Henry; South Carolina (*in part*)
**Wallace, Sir Donald Mackenzie.** Alexander II; Shuvalov or Schouvaloff, Peter Andreivich
**Wallace, Willard M.** Steuben, Frederick William Augustus Henry Ferdinand (*in part*)
**Wallace, William.** Arabian Philosophy (*in part*); Empedocles (*in part*); Hegelian Philosophy (*in part*); Schopenhauer, Arthur (*in part*)
**Wallace, William Stewart.** Canada (*in part*); Quebec (*in part*)
**Wallace-Hadrill, John Michael.** Chilperic; Germany (*in part*)
**Wallis, E. J. N.** El Obeid, Kordofan
**Walrath, Florence Dahl.** Foundling Hospitals (*in part*)
**Walsh, Thomas J.** Montana (*in part*)
**Walston, Sir Charles.** Argos (*in part*)
**Walton, Sir John Charles.** Coolie, Government Departments (*in part*), Jinnah, Mohammed Ali, Pakistan
**Walton, Mary.** Sheffield
**Wang, Chi-Wu.** Japan (*in part*), Korea (*in part*)
**Warburton, George H.** Almond Oil (*in part*), Beeswax (*in part*), Bone, Industrial Uses of (*in part*), Candle (*in part*); Essential Oils (*in part*), Oils, Fats and Waxes (*in part*), Palm Oil (*in part*), Tung Oil (*in part*), Whale Oil (*in part*)
**Ward, Sir Adolphus William.** Drama (*in part*), Jonson, Ben (*in part*), Lodge, Thomas
**Ward, James.** Herbart, Johann Friedrich (*in part*)
**Ward, John S. Marlow,** D.D. Secret Societies (*in part*)
**Ward, Mary A. (Mrs. Humphry Ward).** Lyly, Lilly or Lylie, John (*in part*)
**Wardlaw, William.** Titanium; Tungsten
**Wardle, William Lansdell,** D.D Cain, Cherubim, David (*in part*), Deluge, Eden, Japheth, Lamech; Manasseh (King of Judah); Manasseh (Tribe of Israel), Naphtali, Nimrod, Noah; Paradise, Reuben; Sabbath (*in part*), Samson, Samuel, Saul, Solomon, Uzziah
**Ware, E. E.** Paint (*in part*)
**Ware, W. Porter.** Shaving Mirrors
**Warne, William E.** Land Reclamation
**Warner, Edward Pearson.** Aerial Law
**Warner, Eltinge Fowler.** Shooting (*in part*)
**Warner, Sir Frank.** Silk and Sericulture (*in part*)
**Warre, Rev. Edmond,** D D. Boat
**Warren, Rev. Frederick Edward,** B D Prayer, Book of Common (*in part*)
**Warren, George L.** Nansen International Office for Refugees; Refugees and the Exchange of Populations (*in part*)
**Washburne, Carleton Wolsey.** Supernormal Children, Education of
**Wasson, Thomas C.** Dahomey; French Guinea (*in part*), Gao; Ivory Coast; Jenné, Mauritania
**Waterfield, Lina.** Duse, Eleonora, Venice (*in part*)
**Waters, Edward Thomas.** Diabetes Mellitus (*in part*)
**Watkins, George Benson.** Glass, Safety; Glass, Ultra-Violet Ray Transmitting
**Watson, David Meredith Seares.** Chameleon; Cobra (*in part*); Comparative Anatomy (*in part*); Crocodilian (*in part*), Dinosaur, Embryology (*in part*), Mammoth (*in part*); Palaeontology (*in part*); Plesiosaurus (*in part*); Proboscidea (*in part*); Pterodactyl (*in part*); Reptiles; Skeleton (*in part*); Zoological Geography (*in part*)
**Watson, Rev. Canon Edward William,** D D. Ministry, The Christian
**Watson, F. I.** Coursing; Football (*in part*); Greyhound Racing (*in part*)
**Watson, Floyd Rowe.** Acoustics of Buildings
**Watson, Francis John Bagott.** Caffieri, Jacques; Canaletto
**Watson, George Neville.** Spherical Harmonics
**Watson, Kenneth M.** Butadiene
**Watson, William Henry Lowe.** Apprenticeship (*in part*)
**Watt, Francis.** Inns and Innkeepers (*in part*); Paterson, William (*in part*)
**Watt, James Muir.** Auctions and Auctioneers (*in part*)
**Watt, William C.** Ship Lanes of the North Atlantic (*in part*)
**Watts, Henry C.** Airscrew (*in part*)
**Watts, William Walter.** Bronze and Brass Ornamental Work (*in part*); Iron in Art (*in part*), Pewter
**Watts-Dunton, Theodore.** Poetry (*in part*); Wycherley, William (*in part*)
**Waugh, Arthur.** Pater, Walter Horatio; Pat-

more, Coventry Kersey Dighton
**Waugh, William Templeton.** Montcalm, Louis-Joseph de Montcalm-Gozon
**Wavell, Field Marshall Archibald Percival, 1st Earl Wavell.** Brest-Litovsk, Battles of; Carpathians, Battles of the, Caucasus, Campaign in the, Dunajec-San, Battles of The; Lemberg, Battles of; Lodz, Battle of, Luck or Lutsk, Battles of, Narew, Battles of the; Narocz, Battle of Lake, Palestine, Operations in, Przemysl, Sieges of; Seven Weeks' War; Vistula-San, Battles of the
**Weatherly, Cecil.** Knighthood and Chivalry (*in part*); Saddlery and Harness
**Weaver, Charles Edwin** Oligocene
**Webb, Clement Charles Julian.** Sacrament
**Webb, Walter Prescott.** West, The (*in part*)
**Weber, Frederick T.** Portrait Painting (*in part*)
**Weber, Frederick W.** Burnisher
**Weber, Friedrich.** Arbitration (*in part*)
**Webster, Charles Kingsley.** Diplomacy; Vienna, Congress of
**Webster, David L.** Electricity
**Webster, Captain Frederick Annesley Michael.** Athletic Sports (*in part*); Discus Throwing (*in part*); Running
**Webster, James Claude.** Inns of Court and Chancery (*in part*)
**Wecter, Elizabeth Farrar.** Yale, Caroline Ardelia
**Wedgwood, Camilla H.** Cousin Marriage; Dance (*in part*), Dead, Disposal of the (*in part*), Endogamy; Exchange Marriage; Exogamy; Weapons, Primitive; Weaving (*in part*)
**Weeks, Raymond.** Foreign Languages, Teaching of (*in part*)
**Weerth, Ernest de.** Costume Design (*in part*)
**Wehle, Harry Brandeis.** Painting (*in part*)
**Wehrmann, Arthur M.** Handball (*in part*)
**Weiner, Joseph Lee.** Liquidation (*in part*)
**Weir, Robert Hendry** Wool Industries
**Weiss, Gertrude S.** Budget, Family
**Weller, J. Marvin.** Carboniferous System and Period
**Weller, Thomas Huckle, M.D.** Tropical Medicine
**Wellington, John Harold.** South Africa, Union of (*in part*), South-West Africa (*in part*)
**Wells, Alan Frank.** Casual Labour (*in part*); Casual Ward; Charity (*in part*); Friendly Societies (*in part*)
**Wells, Alexander Frank.** Crystallography (*in part*)
**Wells, Harry Warren.** Ionosphere
**Wells, Joseph.** Oxford University (*in part*)
**Wells, William Thomas.** Banns of Marriage; Bar, The (*in part*); County Court (*in part*); Election; Kenyon, Lloyd Kenyon; Lawyer (*in part*); War Office (*in part*); Will or Testament (*in part*)
**Wenger, John Christian, D.Th.** Mennonites (*in part*); Menno Simons
**Wenley, Robert Mark.** Scepticism (*in part*)
**Wentworth, Chester Keeler.** Boulder; Gravel
**Wentworth-Sheilds, Francis William.** Water-Colour Painting (*in part*)
**Wentzel, Helene L.** Colorado
**Wenzel, Rupert L.** Bookworm; Coleoptera (*in part*); Firefly; Flour Beetle, Glowworm; Pine Beetle; Weevil (*in part*)
**Werden, Lincoln A.** Anglesite (*in part*)
**Werner, Alice.** Hausa (*in part*); Sandawe; Swahili Language
**Werner, M. R.** Rosenwald, Julius; Tammany Hall (*in part*)
**Wernham, Richard Bruce.** Elizabeth I
**Werrenrath, Reinald.** Song (*in part*)
**Werts, Hilary R., S.J.** Celibacy
**West, Arthur Gilbert Dixon.** Microphone or Telephone Transmitter
**West, James Edward.** Boy Scouts (*in part*)
**Westermann, Diedrich Hermann.** African Languages
**Westermarck, Edward Alexander.** Divorce (*in part*); Group Marriage (*in part*); Polyandry; Polygyny
**Westheimer, Frank Henry.** Acids and Bases; Reaction Kinetics
**Westlake, John.** Allegiance (*in part*); Domicile
**Westmore, Perc.** Motion Pictures (*in part*)
**Weston, Edward.** Photographic Art
**Weston, G. J.** Bead Manufacture
**Weston, Jessie L.** Arthurian Legend, Gawain; Grail, The Holy, Guenevere, Lancelot; Mallory, Sir Thomas (*in part*), Map (or Mapes), Walter, Merlin; Perceval, Tristan or Tristram; Wolfram Von Eschenbach
**Weston, T. A.** Flower (*in part*)
**Westphal, Ulrich F.** Imidazole
**Wethey, Harold E.** Spanish-American Architecture
**Wetmore, Alexander.** Archaeopteryx; Diatryma; Herperornis; Ichthyornis; Ornithology (*in part*), Phororhacos
**Wever, Ernest Glen.** Equilibrium, Sense of; Hearing
**Wexler, Harry.** Greenhouse Effect of the Atmosphere; Lapse Rate of Temperature; Radiation Balance of the Earth
**Wexler, Raymond.** Radar (*in part*)
**Whatmough, Joshua.** Latin Language; Oscan; Sabellic
**Wheeler, Henry Paul, Jr.** Helium
**Wheeler, Jane G.** Borku or Borgu
**Wheeler, William Henry.** Rockets (*in part*)
**Wheland, George Willard.** Amides; Amines (*in part*), Aromatic Acids, Coumarone; Decolorizing; Fatty Acid; Free Radicals (*in part*); Isomerism; Lactones; Molecule, Chemical; Parachor; Propiolic Acid; Pyrazines; Pyrene, Stereochemistry (*in part*), Stoicheiometry; Xanthic Acid
**Whipple, Fred Lawrence.** Jupiter (*in part*); Meteor (*in part*); Minor Planet (*in part*); Planet
**Whipple, Leonidas Rutledge.** Censorship (*in part*)
**Whitaker, Katherine Pokan.** Drama (*in part*)
**White, Major General Geoffrey.** Driving (*in part*), Rule of the Road (*in part*)
**White, Henry Seely.** Algebraic Forms; Trigonometry
**White, Irma Lenore Reed.** United States (of America), The (*in part*)
**White, John Forbes.** Rembrandt; Velazquez, Diego Rodriguez De Silva y (*in part*)
**White, Lee A.** Michigan
**White, Leonard Dupee.** Civil Service (*in part*)
**White, Orland Emile.** Amazon (*in part*)
**White, Roy Barton.** Western Union Telegraph Company, The (*in part*)
**White, Wilford Lenfestey.** United States (of America), The (*in part*)
**White, William C.** Alexanderson, Ernst F. W.; De Forest, Lee
**Whitehill, Walter Muir.** World War II (*in part*)
**Whitehorn, John Clare, M.D.** Psychiatry (*in part*)
**Whitehouse, Wallace Edward.** Sweden (*in part*); Switzerland (*in part*); Zeeland (*in part*); Zürich (Canton)
**Whiteley, Martha Annie.** Chemistry (*in part*)
**Whiting, P. W.** Gynander or Gynandromorph
**Whitlock, Herbert Percy.** Gems, Synthetic (*in part*)
**Whitmore, Frank Clifford.** Molecular Rearrangements
**Whittaker, Sir Edmund.** Relativity (*in part*); Space-Time (*in part*)
**Whittaker, William Gillies.** Choral Singing (*in part*)
**Whittle, Lieutenant Colonel H. J.** Croquet (*in part*)
**Whittlesey, Charles R.** Banking (*in part*); Money
**Whitteseey, Derwent.** Abidjan; Accra; Bamako; Bauchi; Cape Coast Castle; Dakar (*in part*), Elmina; Geopolitics; Kano; Lagos; Port Harcourt; Saint Louis; Sekondi, Senegambia, Slave Coast; West Africa (*in part*)
**Whymant, A. Neville J.** Babylonian and Assyria (*in part*); Caspian Languages; Clicks; Hottentots (*in part*), Hudson's Bay Company (*in part*); Huns (*in part*); Ishii, Kikujiro; Khiva (*in part*); Lâo-Tse (*in part*); Mongols (*in part*), Polynesian Languages; Polynesian Literature; Siam (*in part*), Siamese Language and Literature, Turkish Language and Literature (*in part*)
**Whyte, Frederic W.** Du Maurier, George Louis Palmella Busson
**Wichers, Edward.** Atom (*in part*)
**Wickens, George Michael.** Drama (*in part*)
**Wickersham, George Woodward.** Taft, William Howard
**Wiegand, David E.** Electromagnet (*in part*)
**Wieschhoff, Heinrich** [illegible] Bagirmi, Baghirmi or Baguirmi, Cameroons (*in part*); Cazembe; Chinde, French Equatorial Africa, Gabun; Loango, Mozambique, Nyasaland Protectorate (*in part*), Portuguese East Africa or Mozambique [illegible], Portuguese Guinea; Quelimane; [illegible] Unyoro (Bunyoro), Wadelai
**Wigglesworth, V. B.** Metamorphosis (*in part*), Insect (*in part*)
**Wigmore, Colonel John H.** Fielding, Sir John
**Wiklund, K. B.** Finno-Ugrian Languages
**Wilberforce, Sir Herbert William W.** Summary Jurisdiction (*in part*)
**Wilbur, Ray Lyman, M.D.** Leland Stanford Jr University (Stanford University)
**Wilby, Francis Bowditch.** West Point
**Wilcox, Walter W.** Food Supply of the World (*in part*)
**Wilde, J. K. H.** Rinderpest (*in part*)
**Wilder, Raymond Louis.** Point Sets; Topology
**Wilder, Russell M., M D.** Metabolic Diseases
**Wiley, Louis.** Ochs, Adolph Simon
**Wilfred, Thomas.** Clavilux
**Wilkins, Richard A.** Brass Manufactures (*in part*)
**Wilkinson, Walter Hugh John.** Nepal (*in part*)
**Wilks, Dick Lloyd.** New Zealand (*in part*)
**Wilks, Samuel Stanley.** Pearson, Karl
**Willcox, Walter Francis.** Census (*in part*)
**Willcox, Colonel Sir William Henry, M D.** Drug Addiction (*in part*); Poison (*in part*)
**Willett, Hurd Curtis.** Meteorology
**Williams, Rev. A. Lukyn, D D.** Aceldama; Gentile; Hosanna; Judas Iscariot or Scariot; Mammon
**Williams (Arthur Frederic) Basil.** Botha, Louis; George III
**Williams, C. B.** Migration of Animals
**Williams, Brigadier Edgar Trevor.** World War II (*in part*)
**Williams, Hermann W., Jr.** Mount, William Sidney
**Williams, Howel.** Agglomerate; Tuff
**Williams, Sir Ifor.** Welsh Language
**Williams, James.** Prescription (*in part*); Torture (*in part*); Writ of Prohibition (*in part*)
**Williams, John Eryl Hall.** Criminal Appeal, Court of (*in part*); Criminal Law (*in part*); Deportation (*in part*)
**Williams, Lou.** Agricola, Georg
**Williams, Ralph Vaughan.** Folk-Song (*in part*)
**Williams, Robert T.** Bookbinder
**Williams, Russell Byron.** Wire Rope
**Williams, William S.** Band Saws
**Williamson, A. V.** Indian Desert, The; Karachi; Sind (*in part*)
**Williamson, George Charles.** Clouet, François; Clouet, Jean; Cooper, Alexander; Cooper, Samuel; Englehart, George, Hoskins, John, Humphry, Ozias, Miniature Painting (*in part*); Isabey, Jean Baptiste; Isabey, Louis; Isabey, Eugène; Isabey, Georges; John (*in part*); Plimer, Andrew, Pricur, Pierre; Smart, John
**Williamson, James.** Aqueducts; Concrete (*in part*); Ferro-Concrete
**Williamson, William Rulon.** Pensions (*in part*)
**Willihnganz, Eugene.** Battery (*in part*)
**Willis, Frank B.** Republican Party, The (*in part*)
**Willis, Frederick Andrew Graves.** Ireland, Church of
**Willison, Sir John Stephen.** Laurier, Sir Wilfrid

**Willmann, Dorothy Julia.** Sodality of Our Lady, The
**Willoughby, Edwin Elliott.** Jaggard, William
**Wills, Albert P.** Vector Analysis (*in part*)
**Wills, John Elliot.** Agricultural Labourer (*in part*)
**Wilson, Lieutenant Colonel Sir Arnold Talbot.** Persia (*in part*)
**Wilson, Carl Louis.** Flower (*in part*)
**Wilson, Charles Edward.** General Electric Company
**Wilson, Sir Charles William.** Asia Minor (*in part*); Diarbekr (*in part*)
**Wilson, David Alec.** Carlyle, Thomas (*in part*)
**Wilson, Edward Foss.** Wilson and Co., Inc.
**Wilson, Edwin Brayton.** Brooklyn (*in part*)
**Wilson, Francis Graham.** Liberty
**Wilson, Frank John.** Counterfeit Money
**Wilson, George Grafton.** Prize Courts and Prize Law (*in part*)
**Wilson, Graham Selby,** M.D. Bacterial and Infectious Diseases
**Wilson, Field Marshal Henry Maitland Wilson, 1st Baron.** World War II (*in part*)
**Wilson, Herbert Wrigley.** Northcliffe, Alfred Charles William Harmsworth, Viscount; Rothermere, Harold Sidney Harmsworth, 1st Viscount (*in part*)
**Wilson, H. Fred.** Trust Company (*in part*)
**Wilson, James Robert,** M.D. Diet and Dietetics, Infancy
**Wilson, Morley Evans.** Pre-Cambrian
**Wilson, Richard Middlewood.** English Language
**Wilson, T. Carroll.** Coffee
**Wilton, Captain S. T. H.** Dockyards and Naval Bases (*in part*), Fuelling Stations (*in part*); Heligoland Bight; India (*in part*); Press Gang; World War I (*in part*)
**Wimer, David Cleveland.** Soil (*in part*)
**Winfield, Percy Henry.** Writ (*in part*)
**Winkler, A. J.** Grape
**Winter, Charles.** Children; Protective Laws (*in part*)
**Winterbotham, Brigadier Harold St. John Loyd.** Surveying (*in part*)
**Winterich, John Tracy.** Book Collecting (*in part*)
**Wirth, Henry E.** Density (*in part*)
**Wiskemann, Elizabeth.** [illegible] (*in part*)
**Wissler, Clark.** Hunting and Fishing, Primitive (*in part*)
**Witheford, Hubert.** New Zealand (*in part*)
**Withers, Hartley.** Money Market (*in part*)
**Wolf, Abraham.** Absolute; Abstract and Abstraction; Analogy; Apprehension (*in part*); A Priori and A Posteriori; Attention (*in part*); Belief; Category; Causality or Causation; Classification, Common Sense Philosophy; Conceptualism; Cosmology; Descartes, René, Duration and Time; Ethics; Ethics, History of (*in part*); Induction; Innate Ideas; Intelligence or Understanding; Intuition; Laughter; Law; Logic; Logic, History of (*in part*); Meaning; Mechanism; Metaphysics; Monism; Pantheism (*in part*); Philosophy, History of; Probability; Royal Society, The (*in part*); Scientific Method; Spinoza, Benedictus de
**Wolf, Lucien.** Anti-Semitism (*in part*); Zionism (*in part*)
**Wolf, Stewart,** M.D. Psychiatry (*in part*)
**Wolfe, Humbert.** Moore, George; Poetry (*in part*)
**Wolff, Eugene.** Eye, Human (*in part*)
**Wolff, Harold G.,** M.D. Psychiatry (*in part*)
**Wolff, Philippe.** D'Isalguier, Anselme
**Wollam, A. B.** American Sugar Refining Company, The
**Wollam, Park F.** Uruguay (*in part*)
**Wolman, Abel.** Water Purification, Water Supply
**Wood, A. B.** Sound
**Wood, Arthur Evans.** Slum (*in part*); Social Settlements (*in part*)
**Wood, Charles P.** Factory Construction and Planning
**Wood, George McLane.** Argentina (*in part*); Brazil (*in part*), Chile (*in part*), Ecuador (*in part*), Grand Canyon, The, Great Basin, The; Great Salt Lake, Venezuela (*in part*)
**Wood, Herbert George,** Hon. D.D. Bible (*in part*)
**Wood, Richardson.** Public Opinion Surveys
**Wood, Robert E.** Mail-Order Business (*in part*)
**Wood, Robert Williams.** Fluorescence and Phosphorescence
**Wood, W. Birkbeck.** American Civil War; Antietam, Battle of the; Atlanta, Battles Round; Bull Run (*in part*), Chickamauga; Nashville (*in part*)
**Woodbury, David Oakes.** Test Pit
**Woodcock, William H.** Cement (*in part*)
**Woodham-Smith, Cecil.** Nightingale, Florence
**Woodhouse, Thomas.** Hessian (*in part*), Honeycomb; Hose-Pipe, Huckaback, Jute (*in part*), Linen and Linen Manufactures; Matting; Pile, Sailcloth and Sailmaking (*in part*)
**Woodrow, Herbert.** Attention (*in part*)
**Woodruff, Lorande Loss.** Protozoa
**Woods, Maurice Henry.** Birkenhead, Frederick Edwin Smith (*in part*)
**Woodson, Carter Godwin.** Peonage
**Woodward, Sir Arthur Smith.** Ichthyosauria; Iguanodon (*in part*)
**Woodward, Ernest Llewellyn.** Châlons-sur-Marne (*in part*)
**Woody, Thomas.** Wellesley College; Women, Education of
**Woolley, Dilworth Wayne.** Vitamins (*in part*)
**Wooster, W. A.** Agate, Amber; Bloodstone or Heliotrope, Carnelian or Cornelian; Chalcedony or Calcedony; Crystallography (*in part*), Fluorspar; Jade; Jasper, Onyx; Opal
**Working, E. J.** Agricultural Prices (*in part*); Agricultural Statistics (*in part*)
**Workman, E. John.** Thunderstorms (*in part*)
**Wornum, Ralph Nicholson.** Arabesque
**Wornum, W. E.** Carmine (*in part*)
**Worsfold, William Basil.** Africa (*in part*); Cape Province (*in part*); Nigeria (*in part*); Rhodesia (*in part*)
**Wrapp, H. Edward.** Office Machines and Appliances (*in part*)
**Wray, Laurence.** Household Appliances (*in part*)
**Wrenn, Charles Leslie.** English Literature (*in part*); Novel (*in part*)
**Wright, A. H.** Flax (*in part*); Hemp; Phormium or New Zealand Flax; Sunn
**Wright, Charles.** Lloyd's (*in part*)
**Wright, Sir Charles Theodore Hagberg.** Periodical (*in part*)
**Wright, Orville.** Wright, Wilbur (*in part*)
**Wright, Quincy.** Hostage; Mandate (*in part*); Treaties; War (*in part*)
**Wright, Sewall.** Evolution, Organic (*in part*); Genetics of Population
**Wright, Willard Hull.** Trichinosis or Trichiniosis
**Wright, William Hammond.** Mars (*in part*)
**Wrong, George Mackinnon.** Canada (*in part*); Ontario (*in part*)
**Wulfsberg, Fredrik.** Drama (*in part*)
**Wyatt-Paine, W.** Circuits (*in part*), Husband and Wife (*in part*); Inns and Innkeepers (*in part*); Lien (*in part*), Master and Servant
**Wyckoff, Ralph D.** Gravitation (*in part*)
**Wylie, Sir Francis Verner.** Suez Canal
**Wyllie, Brigadier General Robert E.** Colours, Military (*in part*); Flag (*in part*)

**Yaglou, Constantin Prodomos.** Fatigue (*in part*)
**Yamey, Basil Selig.** Chain Store (*in part*)
**Yanofsky, Barney.** Veterans of Foreign Wars
**Yates, H. O.** Chrysanthemum (*in part*)
**Yellin, Samuel.** Iron in Art (*in part*)
**Yewdall, Alexander.** Clothing Manufacture (*in part*)
**Yoe, John H.** Carbon; Carbonic Acid and Carbonates (*in part*)
**Yorke, Philip Chesney.** Ann [illegible] (*in part*); Britain and Ireland (*in part*); Ulick de Burgh, Cromwell, Richard
**Young, Alexander Bell Filson.** Dance (*in part*)
**Young, Allyn Abbott.** Labour, Land, Price; Rent In Economics, Supply and Demand, Utility, Value
**Young, Art (Arthur Henry).** Cartoon (*in part*)
**Young, Ernest.** Siam (*in part*)
**Young, Sir Frederic William.** Salvaging
**Young, Harland Harry.** Gelatin
**Young, John W.** Geometry (*in part*)
**Young, Kimball.** Attitudes, Imitation; Psychology, History of (*in part*); Suggestion
**Young, Mahonri (Mackintosh).** Sculpture Technique (*in part*)
**Young, Owen D.** Dawes, Charles Gates (*in part*)
**Young, Paul Thomas.** Motivation
**Young, Richard.** Waters, Territorial
**Young, Richard Hugh.** Guiana (*in part*); Jamaica (*in part*)
**Young, T. Cuyler.** Persia (*in part*)
**Younghusband, Major General Sir George John.** Crown Jewels or Regalia (*in part*)
**Yugow, A. A.** Rouble (*in part*)
**Yule, Sir Henry.** Hsuan Tsang (*in part*); Kublai Khan; Lhasa (*in part*); Mandeville, Jehan de (*in part*); Polo, Marco (*in part*); Ricci, Matteo (*in part*)
**Yust, Walter.** Encyclopaedia (*in part*)

**Zalowitz, Nathaniel.** Yiddish Language and Literature (*in part*)
**Zanzig, Augustus Delafield.** Music, Teaching of (*in part*)
**Zeisberg, Carl** Table Tennis
**Zeller, John Henry.** Pig (*in part*)
**Zern, Gordon Kay.** Models and Modelmaking
**Zeuner, Frederick Everard.** Quaternary
**Ziegfeld, Edwin.** Schools of Art (*in part*)
**Zigler, Michael J.** Skin, Sensory Functions of; Smell and Taste (*in part*)
**Zimmer, George Frederick.** Bunkering of Ships, Granaries and Grain Elevators (*in part*), Locomotive Coaling (*in part*); Mechanical Handling [illegible] and Telphers; Pneumatic Conveying, Ropeways and Cableways; Wagon Tipplers
**Zimmerman, Carle Clark.** Le Play, Pierre Guillaume Frédéric
**Zimmerman, Colonel George J.** Canal and Canalized Rivers (*in part*)
**Zimmerman, Percy White.** Arboretum; Horse-chestnut (*in part*); Tree (*in part*)
**Zimmern, Sir Alfred.** League of Nations and Education
**Zink, Donald Guyer.** Alcohol; Alcohol in Industry; Amyl Acetate (*in part*); Butyl Acetates (*in part*); Fusel Oil; Glycols (*in part*); Methyl Alcohol Proof Spirit
**Zmeskal** [illegible] (*in part*)
**Zon, Raphael.** Forests and Forestry; Physical Natural Resources (*in part*)
**Zscheile, Frederick** [illegible] and Anthoxanthins (*in part*); Chemistry of
**Zubin, Joseph** Handwriting
**Zworykin, Vladimir K.** Television (*in part*)
**Zygmund, Antoni.** Fourier Series

FOUNDED A.D. 1768

# ENCYCLOPÆDIA BRITANNICA

*A NEW SURVEY OF UNIVERSAL KNOWLEDGE*

## Volume I

## A to ANNOY

A THIS letter has stood at the head of the alphabet during the whole of the period that it can be traced historically. The name of the letter in the Phoenician period resembled the Hebrew name *aleph* and was taken over by the Greeks in the form of *alpha*. In the Phoenician alphabet the letter stood for a species of breathing or inherent sound, since vowels were not represented in the Semitic alphabets. The view that the Greeks received their alphabet directly from the Phoenicians has now been largely abandoned. The character may therefore have stood for a vowel in the alphabet before the Greeks took it over. It must indeed almost certainly have done so if it was in use among the peoples of Asia Minor previous to its use by the Greeks. Throughout its history variations have occurred in the form of the letter. The Phoenician form was . In the Lydian alphabet of the fifth century B.C. it appeared as  , in the Carian alphabet  or  . In the early Greek alphabet from the island of Thera, which may possibly be dated as far back as the eighth or ninth century B.C., its form was  or  . In the Greek alphabet of classical times its form was usually . Early Italian and Latin forms are  and . As early as the middle of the second century A.D. we find  as a form of , and this is the ancestor of our present minuscule printed a by way of uncial  (fourth century) and  (eighth century), uncial writing being the name given to the round hand which in late Roman times superseded the square capitals that had been suitable for inscription in stone. Under the influence of the uncial hand this form was adopted into Carolingian minuscules. Our rounded minuscule *a* derives from Latin cursive, in which in the fifth century A.D. appears the astonishing form . This is a hastily-written majuscule  distorted by its apex having fallen to the left. In the sixth century the cursive form was , and from this in the seventh century develops the form , from which the rounded form of the Irish and early English hands grew. The rounded capital  that sometimes appears in handwriting is the minuscule letter written large.

The sound for which the letter consistently stood in Greek and Latin, and doubtless, generally speaking, in its immediate pre-Greek history, was the open low back vowel, usually known in modern English as continental *a*. There are of course countless slight variations in the method of pronouncing this sound. In English the sound has undergone far-reaching changes during and since the Middle English period. These are due to *fronting*, that is to say, pronouncing the sound more towards the front of the mouth, or to *rounding*, slightly rounding the lips, which has the effect of causing the sound to be pronounced higher in the mouth. At the present time the letter represents six principal vowel-sounds: (1) its original value, the low back vowel, as in *father*,

(2) an intermediate vowel, as in *man;* (3) a closer vowel, further fronted, as in *hare,* occurring only before the liquid *r;* (4) a diphthong (*ei*) as in *take, spade.* This is the sound that the letter now normally represents when the vowel is long. (3) represents a stage in the development of the sound on its way from (1) to (4) which was arrested at this point when the vowel was followed

| NAME OF FORM | APPROXIMATE DATE | FORM OF LETTER |
|---|---|---|
| PHOENICIAN | B.C. 1,200 |  |
| CRETAN | 1,100-900 |  |
| THERAEAN | 700-600 |  |
| ARCHAIC LATIN | 700-500 |  |
| ATTIC | 600 |  |
| CORINTHIAN | 600 |  |
| CHALCIDIAN | 600 |  |
| IONIC | 403 |  |
| ROMAN COLONIAL | PRE-CLASSICAL AND CLASSICAL TIMES |  |
| URBAN ROMAN | |  |
| FALISCAN | |  and |
| OSCAN | |  |
| UMBRIAN | |  |
| CLASSICAL LATIN AND ONWARDS | |  |

THE DEVELOPMENT OF THE LETTER A FROM PHOENICIAN TIMES, THROUGH CLASSICAL GREEK AND LATIN, TO THE PRESENT DAY

by *r.* A similar fronting of this sound took place in the Ionic-Attic dialects of Greek, where sounds derived from the *a*-sound and represented in other dialects by *a* are represented by *η*.

The two remaining developments of the sound are due to rounding: (5) the vowel of *water* and (6) the vowel of *was.* This development is due to the influence of the preceding bilabial spirant *w.*

(B. F. C. A.)

*In Music,* A is the name of the first note of the musical alphabet and constitutes the 6th degree of the scale of C. In respect of pitch A=435.4 vibrations per second, this being the standard pitch or *diapason normal.* A is the note always given to orchestral players, usually by the oboe, for tuning purposes.

(*See* PITCH, MUSICAL.)

**A1 AT LLOYD'S,** a popular expression denoting super-excellence, derived from the prestige of the world's chief shipping registry, Lloyd's Register of British and Foreign Shipping. In fact, the highest classification assigned to iron and steel ships is "100 A1." In this symbol, "100 A" denotes the condition of the hull, while the "1" denotes efficiency of equipment. "A1" is almost obsolete, being the symbol of the highest classification of wooden vessels.

(*See* LLOYD'S REGISTER OF SHIPPING.)

**AA,** the name of many small European rivers. The word is derived from the O. G. *aha,* cognate to the Latin *aqua,* water (*cf.* Ger. *-ach;* Scand. *á, aa,* pronounced *ō*). Among the streams of this name are:—Two rivers in west Russia, falling into the Gulf of Riga with Riga lying between their mouths; a river in northern France flowing through St. Omer and Gravelines, and a river of Switzerland, in the cantons of Lucerne and Aargau, which carries the waters of Lakes Baldegger and Hallwiler into the Aar. In Germany there are the Westphalian Aa, joining the Werre at Herford, the Münster Aa, a tributary of the Ems, and others

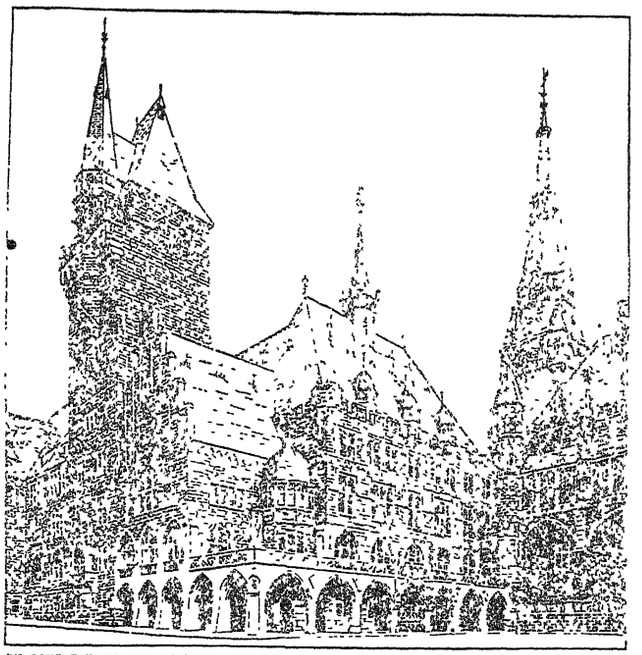
AABENRAA, a town of Denmark, in Aabenraa *amt,* at the head of Sleswig bay, being an arm of the Little Belt. It has a good harbour and a large carrying trade. Pop. (1950) 13,017. From 1864 to 1919 it was in the German province of Schleswig.

**AACHEN** (Fr. AIX-LA-CHAPELLE; Dutch AKEN), ancient city and spa, North Rhine-Westphalia, Ger., under the northern slopes of the Ardennes, on the Cologne-Brussels main line, 44 mi. W. by S. of Cologne. Pop. (1950) 129,811. Its municipal boundaries coincide on the west with the frontiers of Belgium and the Netherlands. In general appearance a prosperous, modern commercial town, it is full of mediaeval associations. The outer town is mainly new; while the ramparts of the old inner town are now promenades, with two ancient gates, Ponttor and Marschiertor, remaining. The hot sulphur springs have been celebrated for centuries. The conspicuous cluster of buildings in the centre of the city includes the cathedral and the Rathaus (town hall), a Gothic structure (1353–70) built on the ruins of Charlemagne's palace, which contains the magnificent coronation hall of the emperors (143 ft. by 61 ft.). The two original towers, Granusturm and Glockenturm, were all but destroyed by fire in 1883; their restoration was completed in 1902. Near the Rathaus is the Grashaus, restored in 1889 to house the municipal archives. The cathedral is in two distinct styles. The Romanesque *Octagon,* begun in 796, the finest extant Carolingian structure, was modelled on San Vitale at Ravenna, and consecrated by Pope Leo III in 805. Emperor Otto III rebuilt it, on the original lines, in 983, after its destruction by Norman raiders. It is surrounded on the first story by a gallery (the Hochmünster) with antique marble and granite columns, of various sizes, brought from Rome, Ravenna and Trier, removed by Napoleon to Paris, but restored after 1815. The mosaic representing Christ surrounded by "the four-and-twenty elders," which originally lined the cupola, was executed in 1881 from a 17th century copy of the ancient originals The bronze west doors date from 804. Underneath the dome, tradition places the tomb of Charlemagne, said to have been opened by Otto III in 1000 and to have shown the emperor's body on a marble chair which was removed and long used for coronations. It is now in the gallery. The site of the tomb is marked by a stone slab, with the inscription *Carlo Magno,* and above it hangs the famous bronze chandelier presented by the emperor Barbarossa in 1168. In the Hungarian chapel, to the south-west, is the rich Cathedral Treasury, with fine mediaeval work such as the 13th century gold casket containing the relics of Charlemagne. The Gothic choir was added during the 14th and 15th centuries and contains the tomb of the emperor Otto III. The pulpit, a gift of emperor Henry II., dates from *c.* 1020. The cathedral possesses many relics, the more sacred of which are exhibited only once every seven years, when they attract large crowds.

The churches of St. Foillan (founded in the 12th century, but twice rebuilt, in the 15th and 17th centuries, and restored in 1883) and St. Paul, with its beautiful stained-glass windows, are interesting. The Suermondt museum contains fine pictures by early German, Dutch and Flemish masters. There are many fine streets, squares and public monuments. The fountain in the market square is surmounted by a statue of Charlemagne. In the principal square, Friedrich-Wilhelmplatz, is the Elisenbrunnen, with its colonnade and garden, the chief resort of visitors taking the baths and waters.

Since the working of extensive coalfields in the district almost every branch of iron industry has been carried on. Cloth, glass, needles and pins are important products. The suburb of Burtscheid, incorporated with Aachen in 1897, has old-established manufactures of cloth and needles and contains, among frequented thermal springs, the Schwertbad-Quelle (171°F.), the warmest spring in Germany.

**History.**—The ancient city and watering place of Aachen represents the Aquisgranum of the Romans, named after Apollo Granus, who was worshipped in connection with hot springs. As early as A.D. 765 King Pippin had a "palace" there, in which it is probable that Charlemagne was born. The greatness of Aachen was due to the latter, who between 777 and 786 built a magnificent palace on the site of that of his father, raised the place to the rank of the second city of the Empire, and made it for a while the centre of Western culture and learning. From the coronation of Louis the Pious in 813 until that of Ferdinand I. in 1531 the sacring of the German kings took place at Aachen; as many as 32 emperors and kings were crowned there. Late in the 12th century (1172–76) the city was surrounded with walls by order of the emperor Frederick I., to whom (in 1166)



BY COURTESY OF REICHSZENTRALE FUR DEUTSCHE VERKEHRSWERBUNG

THE RATHAUS OR TOWN HALL AT AACHEN, ERECTED IN 1353–70 ON THE SITE OF THE PALACE OF THE EMPEROR CHARLEMAGNE

and to his grandson Frederick II. (in 1215) it owed its first important civic rights. In the 16th century Aachen began to decline.

It lay too near the French frontier to be safe, and too remote from the centre of Germany to be convenient, as a capital; and in 1562 the election and coronation of Maximilian II. took place at Frankfort-on-Main, a precedent followed till the extinction of the Empire. In 1815 it was given to Prussia. In Nov. 1918, at the conclusion of World War I, Aachen was occupied for a period by Belgian troops.

During World War II, because of its important aerodrome and railway connections, it was bombed many times by the Allies.

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**AAHMES:** *see* AMASIS.

**AAL,** also known as A'L, ACH, or AICH, the Hindustani names for the *Morinda tinctoria* and *Morinda citrifolia,* plants extensively cultivated in India on account of the reddish dye-stuff which their roots contain. The name is also applied to the dye, but the common trade name is *Suranji.* Its properties are due to the presence of a glucoside known as *Morindin,* which is compounded from glucose and probably a trioxy-methyl-anthraquinone.

**AALBORG,** seaport on the south bank of the Limfjord, North Jutland, Denmark, capital of Aalborg *amt,* and one of Denmark's oldest towns. Pop. (1940), 55,652. It is the seat of a bishop (1554) and has some old buildings, Jens Bangs Stenhus, the castle called Aalborghus, the Holy Ghost monastery and the Budolfi church. The municipal privileges date from 1342. Industries include cement works, tobacco works, distilleries, chemical works (sulphuric acid and superphosphate), cloth mills and the ship yard.

**AALEN,** a town in Württemberg, Germany, situated on the Kocher, a tributary of the Neckar, at the foot of the Swabian Alps, about 50m. E. of Stuttgart. Pop. (1939) 16,003. Woollen and linen goods and ribbons are manufactured, and there are tanneries and large iron works. Aalen was a free imperial city from 1360 to 1802, when it was annexed to Württemberg.

**AALESUND** (or ÅLESUND), seaport of Norway, in Møre fylke (county), 160 mi. N. by E. of Bergen by sea. Pop. (est. 1936) 18,350. It is built on three islands, Nørvø, Aspø and Hissen, enclosing the harbour. Founded in 1824, Aalesund is an important export town for fish and fish products. It lies in a very productive fishing district; to the northwest lie the great cod-banks of Storeggen and Nyeggen. Vessels also fish off Iceland, while a fleet of sealing boats is sent to the Arctic ocean. There are numerous factories connected with the fish industry and oil refineries, engineering works and a seining factory. Aalesund is ordinarily a port of call for the Norwegian South American line (on account of the export of klip-fish) and for the routes Trondhjem–Hamburg, Trondhjem–France and Trondhjem–England, and also for most coasting vessels trading in western Norway. There is some [illegible] connected with the adjacent centres of Geiranger and Jørund fjords. In 1904 Aalesund was wasted by a terrible fire. In the following years the town was planned on new lines and the houses in the centre were built of brick. German troops occupied Aalesund in 1940.

**AALI MEHEMET,** PASHA (1815–1871), Turkish statesman, was born at Constantinople, the son of a government official. He was ambassador in London (1842–45), and then foreign minister under Reshid Pasha. He took part in the congress of Vienna (1855) and in the congress of Paris (1856), and was five times grand vizier. Aali Pasha was one of the most zealous advocates of the introduction of Western reforms under the Sultans Abdul-Mejid and Abdul-Aziz. He died at Erenkoi in Asia Minor on Sept. 6, 1871.

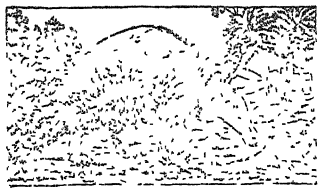
**AALSMEER,** a town in the province of North Holland, Holland, situated in low country about 10 mi. S.W. of Amsterdam. Pop. (1940) 10,420. It has railway communication with Haarlem and Utrecht. The flat country with its fertile sandy soil, which can be easily watered, provides ideal conditions for horticulture, and the town is surrounded by flower gardens and plant nurseries. Large quantities of plants, bulbs and blooms are exported annually. Aalsmeer was taken by Germany in May 1940.

**AAR** or **AARE,** the largest river entirely within Switzerland. It rises in the great Aar glaciers, in the canton of Berne, west of the Grimsel pass. Beyond the Handegg waterfall the river traverses the Hasli Thal and expands into the Lake of Brienz, where it becomes navigable. It then crosses the swampy plain of the Bödeli, between Interlaken (left) and Unterseen (right), before again expanding into the Lake of Thun. Running north-north-west it encircles the lofty bluff on which the town of Berne is built, and then turns west, and later north. Near Aarberg its stream is diverted west by the Hagneck canal into the Lake of Bienne whence the Nidau canal runs east to Büren. Henceforth its long north-east valley drains the central lowland of north Switzerland, parallel to the Jura. The chief tributaries in this stretch are the Grosse Emme, Wigger, Suhr and Aa, all from the right. Below Brugg it receives first the Reuss, and then the Limmat or Linth. It now turns due north, and soon becomes itself an affluent of the Rhine (left), which it surpasses in volume when they unite at Coblenz, opposite Waldshut. Length of river, 181m. Area of basin, 6,804sq.m.

**AARAU,** the capital of the Swiss canton of Aargau. Pop. (1930), 11,666, mostly German-speaking Protestants. It is on the right bank of the Aar at the southern foot of the Jura, about 50m. by rail north-east of Berne, and 31m. north-west of Zürich An ancient fortress, it was taken by the Bernese in 1415, and in 1798 became for a time the capital of the Helvetic republic.

Eight miles by rail north-east are the famous sulphur baths of Schinznach, near which is the ruined castle of Habsburg, the original home of that house. Industries include silk-ribbon weaving, foundries, cutlery, electrotechnical products and scientific instruments. Aarau is an important military centre.

**AARDVARK** (ard'vark), "earth-pig," the Dutch name for ant-eating mammals of the genus *Orycteropus*, confined to Africa (*see* EDENTATA). The typical form is *O. a. afer*, or Cape-ant-bear from South Africa; other races are found northward, both in forest and plains country to Senegal and the Sudan. The body is stout, with arched back; the limbs are short and stout, armed with strong, blunt claws; the ears long; and the tail thick at the base and tapering gradually. The elongated head is set on a short thick neck, and at the extremity of the snout is a disc in which the nostrils open. The mouth is small and tubular, furnished with a long extensile tongue. A large individual measured 6 ft. 8 in. In colour the Cape aardvark is pale sandy or yellow, the hair being scanty and allowing the skin to show; the northern aardvark has a still thinner coat, a shorter tail and longer head and ears. These animals are nocturnal and burrowing. The strong claws make a hole in the side of the anthill, and the insects are collected on the extensile tongue.



THE CAPE AARDVARK OR ANTEATER OF AFRICA WHICH GROWS USUALLY TO A LENGTH OF ABOUT 5 FT.

**AARDWOLF** (earth-wolf), a South and East African carnivorous mammal (*Proteles cristatus*), like a small striped hyena, but with a more pointed muzzle, sharper ears and a long erectile mane. It is burrowing in habit and feeds on termites.

**AARGAU**, a canton of north Switzerland, comprising the lower course of the River Aar (*q.v.*), whence its name. Its total area is 548 sq mi. It forms the northeastern section of the great Swiss plateau which occupies the trough between the Alps and the Jura. Its fertile valleys alternate with pleasantly wooded hills.

In 1415 the Aargau region, previously the centre of the Habsburgs, was taken from them by the Swiss Confederates. Berne kept the southwest portion. In 1798 the Bernese part became the canton of Aargau of the Helvetic republic and the remainder of the Aargau region formed the canton of Baden. In 1803 the two halves (plus the Frick glen, ceded in 1802 by Austria to the Helvetic republic) were united under the name of Canton Aargau and admitted to membership in the Swiss confederation.

The population of the canton in 1941 was 269,873, almost exclusively German-speaking, with Protestants predominating. The canton, the capital of which is Aarau (*q.v.*), is governed by an executive council of five elected by direct vote. Principal industries include silk-ribbon weaving, electro-technique production and the production of tobacco and wines. Baden (*q.v.*), an important city of the canton, has a tourist industry dependent on its hot sulphur springs. The canton sends 12 members (on the basis of the 1941 census) to the federal *Nationalrat*.

**AARHUS**, seaport and second city of Denmark, capital of Aarhus amt, east coast of Jutland, on Aarhus bay. Pop. (1940) 99,881. It is first mentioned as a town in the 12th century, since when, at least, it has been the seat of a bishop. The town's first charter is dated 1441. Aarhus has a large harbour of three basins. It is the shipping and commercial centre for Jutland and is also known for its iron and oil industries. The district is low-lying, fertile and well wooded.

**AARON**, the traditional founder and head of the Jewish priesthood, who, in company with Moses, led the Israelites out of Egypt (*see* EXODUS, THE; MOSES). His association with Moses in this matter goes back to an ancient tradition, current in northern Israel, though the records derived from the south do not seem to mention him till after the Exile.

In the earlier narratives of the Pentateuch Aaron is mentioned in connection with four events only, (*a*) the Exodus itself, where he appears as the companion of Moses, (*b*) as supporting Moses at the battle of Rephidim, (*c*) as the maker of the golden calf (*see* CALF, THE GOLDEN) and (*d*) as rebelling, along with his sister Miriam, against the authority of Moses, on the ground that the latter had married a foreign wife (Num xii). It may be conjectured that his name did not occur in the original story from which the narrative of Ex. xxxii. was ultimately derived, but as it stands the passage suggests—as does also (*d*)—that there was a tradition of hostility between Moses and Aaron, rather than one of association.

Throughout the period of the monarchy (at least since the death of David) and even in Ezekiel, the legitimate priests at Jerusalem belong to the house of Zadok. It is only after the Exile that Aaron takes his place. In the whole of the sacerdotal literature, commonly ascribed to P, Aaron stands by the side of Moses. The latter is the representative of the secular power of Yahweh, Aaron is his religious vice-gerent. Thus he takes a share in producing the plagues in Egypt, stands by his brother's side (in the pre-exilic narratives he is called the brother of Miriam, but not of Moses) by the Red sea, wields the sacred rod, is chosen and miraculously vindicated as high priest, and is made the centre of the whole ritual system.

The process by which tradition changed Aaron from being a possible rival to Moses into his ecclesiastical counterpart, has never been satisfactorily explained. R. H Kennett has advanced the theory that the Aaronides were originally the priests of Bethel, and that their post-exilic position in Jerusalem was due to a compromise made during or shortly after the Exile This theory certainly offers an explanation of several difficulties, but there are others which it fails to meet, and hence it has not met with general acceptance. (T. H. R.)

**AARON'S ROD**, the popular name given to various tall flowering plants such as garden orpine, or live-for-ever, great mullein and goldenrod. In architecture the term is given to an ornamental rod with sprouting leaves, or sometimes with a serpent entwined round it (from the Biblical references in Exodus vii. 10 and Numbers xvii. 8).

**AARSSENS** or AARSSEN, **FRANCIS VAN** (1572–1641), Dutch diplomatist and statesman. Johan van Oldenbarneveldt sent him, at the age of 26 years, as a diplomatic agent of the States-General of the United Provinces to the court of France He helped to negotiate the 12 years' truce in 1606. Recalled from his post by Oldenbarneveldt in 1616, he was one of the "packed" court of judges who in 1619 condemned the aged statesman to death. For his share in this judicial murder a deep stain rests on the memory of Aarssens. He was confidential adviser on foreign affairs to Maurice, prince of Orange, and afterwards to Frederick Henry, and was sent on special embassies to Venice, Germany and England.

**AASEN, IVAR** (1813–1896), Norwegian philologist and lexicographer, was born at Aasen i Orsten, in Sondmore, Norway, Aug. 5, 1813. His first publication was a small collection of folk-songs in the Sondmore dialect (1843). The *Grammar of the Norwegian Dialects* (1848) and the *Dictionary of the Norwegian Dialects* (1850) prepared the way for the wide cultivation of the popular language in Norwegian, since Aasen really did no less than construct, out of the different materials at his disposal, a popular language or definite *folke-maal* for Norway. With certain modifications, this artificial language is that which has been adopted ever since by those who write in dialect and which later enthusiasts have endeavoured to impose upon Norway as her official language in the place of Dano-Norwegian. Aasen composed poems and plays in the composite dialect and continued to enlarge and improve his grammars and his dictionary Quite early in his career (1842) he had begun to receive a stipend to enable him to give his entire attention to his philological investigations, and the *Storting* treated him with more generosity as he grew older. Aasen holds perhaps an isolated place in literary history as the one man who has invented, or at least selected and constructed, a language which pleased so many thousands of his countrymen that they accepted it for their schools, their sermons and their songs. Aasen died in Christiania, Sept. 23, 1896.

**AASVOGEL**, the name by which the South African species of vultures (*q.v.*) are known. Literally it means "carrion-bird."

**AB,** the fifth month of the ecclesiastical year of the Jews. It corresponds to the period of July 15 to Aug 15. The word is of Babylonian origin; adopted by the Jews after the Babylonian exile

On the ninth is kept the Fast of Ab, or the Black Fast, to bewail the destruction of the first temple by Nebuchadrezzar (586 B.C.) and of the second by Titus (A.D. 70).

**ABA,** (1) a form of altazimuth instrument invented by, and called after, Antoine Thomson d'Abbadie; (2) a rough home-spun manufactured in Bulgaria; (3) a long coarse shirt worn by the Bedouin Arabs.

**ABĀBDA,** a nomad tribe of Arabs who reach northward to the Kena-Kuṣayr road, in the country east of Luxor Dirán, Aswán and the Northern Atbai. They call themselves "sons of the Jinns," and they are the Gebadei of Pliny and probably the Troglodytes of classical writers From time immemorial they have acted as guides to caravans through the Nubian desert and up the Nile valley as far as Sennar. Many of them are employed in the telegraph service across the Arabian desert. They are great trade carriers and visit far away districts. The Abābda of Egypt, numbering some 30,000, are governed by an hereditary "chief"; they generally speak Arabic mingled with Barabra words. As a tribe they claim descent from Selman, an Arab of the Beni Hilál They have adopted the dress and habits of the fellahin. In Nubia they live in villages, and their principal means of livelihood include agriculture, fishing, peddling, charcoal-burning, wood-gathering and trading in gums and drugs The Abābda build huts with hurdles and mats or live in natural caves. Their chief means of transportation is the camel and their chief foods are milk and durra. They are very superstitious, believing, for example, that evil would overtake a family if a girl member should, after her marriage, ever set eyes on her mother; hence the Abābda husband has to make his home far from his wife's village In the Mahdist troubles (1882–98) many "friendlies" were recruited from this tribe.

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**ABACÁ FIBRE,** the most valuable of all fibres for cordage, the product of *Musa textilis* (family Musaceae). This fibre is also known in the trade as manila and manila hemp, but abacá is a hard fibre and is entirely different from true hemp, which is a soft fibre and is the product of *Cannabis sativa.*

The abacá plant, which resembles in appearance the banana and plantain, to which it is closely related, is a perennial growing from short rootstocks. Numerous suckers grow from the rootstocks, forming a cluster of stalks 10 to 25 ft. in height. These stalks are formed by the broad, overlapping leaf stems and bear at the top a crown of large, undivided leaves. The point of growth is at the base, and the fibre is obtained from the outer portion of each successive leaf stem The flower stalk is pushed up through the centre of the plant, bearing at the top flowers that are followed by fruits similar to small bananas but filled with black seeds. Abacá plants grown from seeds do not come true to type, and this plant is propagated from suckers or from rootstocks.

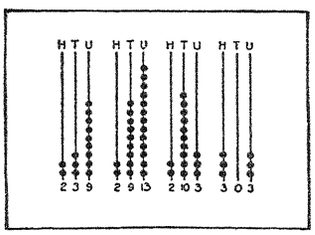
The abacá plant flowers when about two years old, at which stage it is in the most favourable condition for the production of fibre. The stalk is then cut down, and the outer [illegible] layer of each successive leaf stem is stripped off in the form of ribbons, known as "tuxies." The tuxies are pulled under a knife that is pressed against a block of wood by means of a bamboo spring. This scraping process removes the pulp and other waste material, leaving the cleaned fibre in the hands of the operator The fibre so cleaned has only to be hung up to dry in the open air, when, without further treatment, it is ready to be graded and baled for shipment. A small machine that is an adaptation of the hand cleaning process is used rather extensively in the Philippines. In operating this machine, the tuxie is looped around a revolving wooden spindle, which draws it under the stripping knife. Large automatic machines, of the same type as the sisal-cleaning machines, are used for cleaning abacá fibre in the Netherlands Indies and in countries of Latin America

The quality or grade of abacá fibre is determined by the part of the stalk from which the fibre is obtained, by the amount of serration of the stripping knives and the degree of tension holding the knife against the block, and by prompt and careful drying of the fibre. The outer sheaths of the abacá stalk contain a rather short, strong but discoloured fibre; the middle sheaths produce a fibre of medium colour and good strength; the sheaths near the centre of the stalk have a very white, fine fibre of medium strength. In the process of cleaning abacá fibre, the use of coarsely serrated stripping knives and the lack of proper tension on the stripping knife result in the production of coarse, low-grade fibre. Delay and carelessness in drying affect both the colour and the strength of the fibre.

The exceptional strength of abacá fibre and its quality of resistance to the action of salt water make it particularly suitable for marine cordage It is also largely used for well-drilling cables, hoisting ropes and various other types of rope where strength and durability are required. Henequen and sisal have largely replaced abacá as a binder twine fibre. In the Philippines the superior grades of abacá are used for textile fabrics, hats, slippers rugs and various other articles. In Japan, large quantities of abacá fibre, and particularly the waste products, are used for the manufacture of paper From the old and disintegrated ropes is made the well-known manila paper

The abacá plant has been introduced into many different tropical regions, including the Netherlands Indies, India, the Andaman Islands, the West Indies and Central America; formerly the commercial production of this fibre was confined to the Philippine Islands. About 1921, shipments of abacá rootstocks were made from the Philippine Islands to Sumatra, where fairly large plantings were made Despite some expansion of the industry there, it remained relatively unimportant. Small abacá plantings were also made in North Borneo. In 1925 a shipment of propagating material of the superior varieties of abacá was brought from the Philippine Islands to the Republic of Panama by the United States department of agriculture. It was determined by experimental plantings that the climatic and soil conditions of this region are suitable for the abacá plant; that this plant is resistant to the more serious diseases of the banana plant and that abacá fibre of excellent quality can be produced in tropical America. In 1937 and 1939 these plantings were expanded to about 2,000 acres, and in 1942 there was a larger expansion both in Panama and in other countries of Central America (H T. Es.)

**ABACUS,** an early device for tracing numerals on a dust covered board. There have been three standard types: (1) a board covered with dust, whence the derivation, or, at a later period, with wax, and serving the same purpose as a slate in the 19th century or as the modern pad of paper; (2) a table marked with lines upon or between which were placed loose counters in the form of small discs of metal, bone, glass or other material, or (in China) in the form of rods; and (3) a table on which the counters were fastened by means of grooves.




FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 1.—A PROBABLE FORM OF EARLY COMPUTATION

The lines represent hundreds, tens and units. The computation represented is:
239 + 64 = 29[13] = 2[10]3 = 303

The early counter abacus was a table with lines to represent units, tens, hundreds, etc., or to represent different units of value, like pounds, shillings and pence Addition on such an abacus was doubtless performed as represented in fig. 1, which shows the successive steps in the addition of 64 and 239. Subtraction was simply the process of taking away counters; multiplication was considered as repeated addition, and division as repeated subtraction. This type of abacus was known in the Mediterranean countries, and Herodotus (c. 450 B.C.) is authority for the statement that the Egyptians wrote their figures

and reckoned with pebbles "bringing the hand from right to left," while the Greeks proceeded in the opposite direction. There are several references to the abacus in Roman literature, and what is apparently a Greek computing table was found in the 19th century on the island of Salamis.

Latin writers tell of three types of abacus in use in Rome,

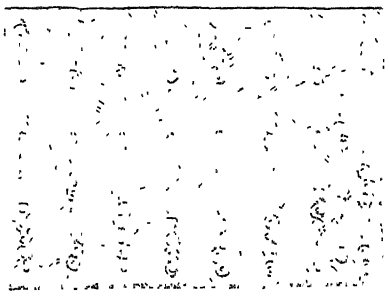


FIG 2

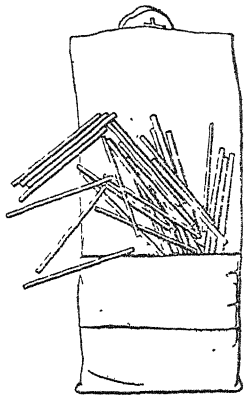


FIG. 3

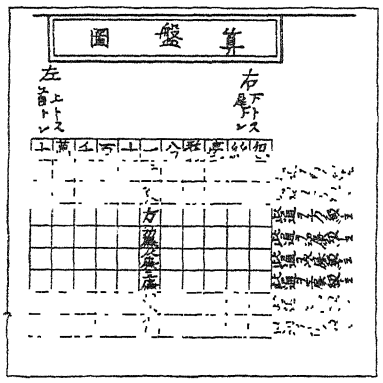



FIG. 4

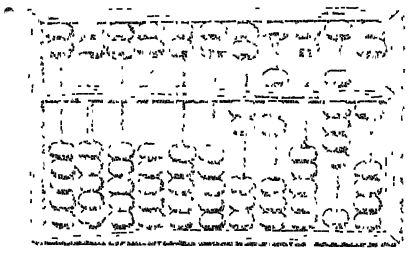


FIG. 5

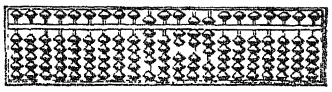


FIG. 6

FROM SMITH, "HISTORY OF MATHEMATICS"

VARIOUS TYPES OF EARLY COMPUTING DEVICES

Fig. 2.—A late Roman abacus, whose source is unknown. This bronze piece of uncertain date has grooves in which the counters slide. Each upper button represents five units and each lower button one unit of the order in which the column stands

Fig. 3.—Korean computing rods. Made of bone, these rods were used in the native Korean schools until the end of the 19th century

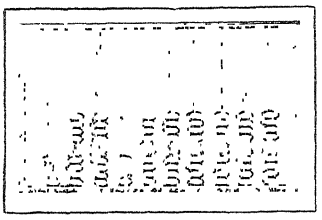
Fig. 4.—A Japanese ruled "Sangi" board. Upon this board the computing rods ("Sangi") were placed to represent algebraic coefficients

Fig. 5.—A modern Chinese abacus. The "suan-pan" was used as early as the 12th century. The number represented is 27091. Each upper bead has a value of five of its order and each lower bead the value of one of its order. Often employed in Chinese laundries

Fig. 6.—A Japanese abacus. The "soroban" was in use as early as the 16th century. The number represented in the central part is 90278

namely: (1) the sand board or the wax tablet, (2) a marked table for counters, and (3) a table with grooves in which the counters were free to slide. Fig. 2 shows a late Roman abacus now in the British museum, each upper button representing five units of the order in which the column stands, and each lower button representing one unit of the same order. Cicero (*Phil. Frag.*, V, 59) speaks of the counters as *aera* (bronzes), but the common name was *calculi* (pebbles) or *abaculi*, the pieces being made of stone, ivory (Juvenal, xi, 131), metal or coloured glass (Pliny. *Hist. Nat.*, xxxvi, 26, 67).

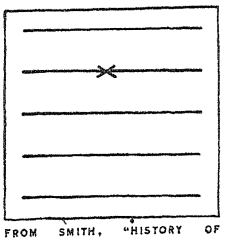
The earliest type of abacus in China seems to have been the "bamboo rods" that served instead of counters These were known as early as the 6th century B.C. and they survived in Korea until the close of the 19th century (fig. 3). They found their way into Japan about the year 600 and were known as *sangi* or *sanchu*. Until recent times they were used to represent algebraic coefficients, being placed on a board ruled as shown in fig 4



FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 7.—A RUSSIAN ABACUS

The "s'choty" of the Russians, "choreb" of the Armenians or "coulba" of the Turks. The wires are slightly arched, a feature which is not shown in the illustration



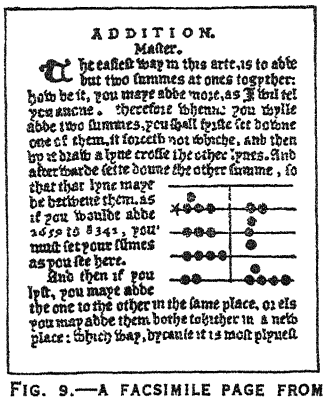
FROM SMITH, "HISTORY OF MATHEMATICS"

FIG. 8.—A MEDIAEVAL COMPUTING TABLE

This method of ruling the computing board was extensively used in the middle ages

Since the 12th century the *suan-pan* (computing tray; *see* fig. 5) has been generally used throughout China. The chief difference between this and the Roman abacus lies in the fact that it has one more bead in each section. In the 16th century this type, slightly changed and bearing the kindred name of *soroban* (fig 6), found its way into Japan, where it is still in use. An abacus differing considerably from the Roman or oriental types is found in the middle eastern countries. The Turks call it the *coulba;* the Armenians, the *choreb;* and the Russians, the *s'choty* (fig. 7). As in the case of the *suan-pan* and the *soroban*, this permits of rapid computation and serves a purpose similar to that of the modern calculating machines (*q.v.*).

There appeared in Europe in the middle ages the line abacus. This type of abacus consisted of a table ruled with horizontal lines representing the successive powers of ten, each space representing half the value of the line immediately above it (fig. 8). This type was in use until well into the 18th century. A pupil who could compute on such a table was said to "know the lines," and the verb "to abacus" was used as the equivalent of the verb "to compute." The method employed may be inferred from a passage in Robert Recorde's *Ground of Artes* (about 1542) as shown in fig. 9.



ADDITION.

Master.

The eaſieſt way in this arte, is to adde but two ſummes at ones together: how be it, you maye adde more, as I ſhall ſet you eaſine. Therefore whenne you wylle adde two ſummes, you ſhall fyrſte ſet bothe one of them, it forceth not whiche, and then by it draw a lyne croſſe the other lynes. And after warde ſette downe the other ſumme, ſo that that lyne maye be betweene them, as if you wouldſt adde 2659 to 8342, you muſt ſet your ſummes as you ſee here.

And then if you lyſt, you maye adde the one to the other in the ſame place, or els you may adde them bothe together in a newe place: which way, becauſe it is moſt playne

FIG. 9.—A FACSIMILE PAGE FROM ROBERT RECORDE, "GROUND OF ARTES"

This reduced page, from the edition of 1558, shows the first step in the addition of 2659 and 8342

The discs that were used in computing were commonly known in Great Britain as "counters" (countures, cowntouris); in the Latin books as *projectiles* (*pro*, forward, + *jacere*, to throw), being thrown or cast upon the counting board, or as *denarii supputarii* (computing pennies); and in France as *jetons* (with many such variants as *gects, jectoirs, gietons* and *jettons*, from *jacere*, to throw). In Germany a counter was called a *Rechenpfennig* or *Zahlpfennig* (number penny). Such later expressions as "cast an account," "borrow one," "carry two," and possibly "lay a wager" have their origin in this kind of computation. The Court of the Exchequer, the "counting house," the "counter" in the modern shop, billiard counters, poker "chips," and various games trace their origin to the counting board.

Gerbert (*c.* 1000), who became Pope Sylvester II, invented an "arc abacus" in which each counter bore a certain Indo-Arabic numeral excepting the zero, the periods in groups of three being united by an arc. It had little recognition, however, for as soon as the significance of the zero became apparent (*see* NUMERALS) it was manifestly of no value.

(*See* CALCULATING MACHINES; FINGER NUMERALS)

(D. E. S.)

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**ABACUS,** in architecture, the upper member of a column capital whose function is to provide a supporting surface for the structure above. In Egyptian capitals it is smaller than the parts below and in the late work it has great height. In the Greek Doric order it is a plain square slab, but in the Roman Doric it is usually crowned by a moulding. In the Greek Ionic order it is at first rectangular, to cap the projection of the volutes, but later becomes square, except at corner capitals where it is curved out over the angle volutes. In both Greek and Roman Corinthian orders and in the composite and four-sided or Scamozzi Ionic order it is moulded with concave sides and usually the corners are cut off slightly. In Romanesque architecture the abacus usually is square, with sides splayed or moulded, and in the Gothic, outside of England, it is square or octagonal and richly moulded. In English Gothic, however, circular forms are frequent, especially in 13th-century work. The diminutive, *abaciscus,* is applied to the squares of a tessellated pavement.

**ABADAN** (Iran), an island situated in the delta of the Shatt-al-Arab (*q.v.*), 40 mi. in length, from 2 to 12 mi. in breadth, bounded on the north and east by the Karun river (*q.v.*) and its tributary, the Bahmishir, on the west by the Shatt-al-Arab, and on the south by the Persian gulf. It is known to Arabs as Jazirat-ul-Khidhr from a tomb situated on the Bahmishir dedicated to the saint of that name. Abadan is referred to by the historian Nasir Khusrau, writing in the 13th century, as the most southerly settlement of Mesopotamia, and it is not improbable that it is identical with the site of the port Charax mentioned by Herodotus. The possession of this island was long in dispute between Persia and Turkey. It was definitely allotted to Persia by the treaty of Erzerum, 1847, the Turks however retaining control of the whole of the Shatt-al-Arab while ensuring to Persia freedom of navigation.

In 1909 the Anglo-Persian Oil Company, Ltd. (*q.v.*), under a lease agreement with the local overlord, the sheikh of Mohammerah, established its pipe-line terminus and refinery on the island between the hamlets of Braim and Bawardah, and this settlement, now known as Abadan (lat. 30° 21′ N., long. 48° 17′ E.), developed into a town of between 50,000 and 60,000 people, organized by the Iranian government as a municipality. Fifteen deep-water jetties have been built along the foreshore to facilitate the loading of tankers and the unloading of machinery, etc. Exports of oil during 1942 from Abadan totalled nearly 5,000,000 tons. During the same period imports of machinery, etc., unloaded at Abadan totalled about 85,000 tons, with a value of more than 164,000,000 rials. There is an excellent equipment of derricks and travelling cranes and several berths for good-sized vessels. The distance along the pipe line from Masjid Suleiman to Abadan is about 137 mi. Communication exists by a very good motor road from Abadan to Mohammerah, 9 mi.; from Abadan to Ahwaz up the pipe line, 78 mi., and thence to Masjid Suleiman, a further 68 mi. A motor road also exists from Basra (*q.v.*) to Sibah, opposite Abadan, on the right bank of the Shatt-al-Arab.

*See* J. W. Williamson, *In a Persian Oil Field,* 2nd. ed. (1930).

**ABADDON,** a Hebrew word meaning "destruction." In poetry it comes to mean "place of destruction," and so the underworld or Sheol (*cf.* Job xxvi, 6). In Rev. ix, 11 Abaddon is used of hell personified, the prince of the underworld. The term is here explained as Apollyon (*q.v.*), the "destroyer."

**ABADEH,** a small town of Iran, lying more than 6,000 ft. above sea level in a fertile tract on the road between Isfahan and Shiraz. It has telegraph and post offices, and is famed for its woodwork; small boxes, trays and spoons with elaborately carved lacelike handles are made of pear and boxwood.

**ABAE,** a town in Greece, in the northeastern corner of Phocis, famous in early times for its oracle of Apollo, one of those consulted by Croesus (Herod. i, 46). Its rich treasures (Herod viii, 33) were sacked by the Persians, and the temple remained ruinous. The oracle was, however, still consulted, *e.g.,* by the Thebans before Leuctra (Paus. iv, 32, 5). The temple, burned again during the Sacred War, was very dilapidated when seen by Pausanias (x, 35); some restoration and the building of a new temple was undertaken by Hadrian. Privileges due to the sanctity of the shrine (*Bull. Corresp. Hell. vi,* 171), were confirmed to the people of Abae by the Romans. The polygonal walls of the acropolis may still be seen, with one gateway and traces of town walls below. *See* V. W. Yorke, "Excavations at Abae," *Journal of Hellenic Studies,* 16: 291–312 (London, 1896).

**ABAILARD:** *see* ABÉLARD, PETER.

**ABAKANSK,** or Abakan, capital of Khakass autonomous region in the Krasnoyarsk province of the R.S.F.S.R. Pop. of region (1939) 270,655. Area 19,276 sq mi. It is situated in 54° 26′ N. and 91° 15′ E., north of the junction of the Abakan river with the Yenisei river; it is a river port with a wharf. It lies in the fertile and sheltered Minusinsk oasis and is linked by river to Krasnoyarsk on the Trans-Siberian railway; the railway from Achinsk to Minusinsk passes it on the west bank of the river. It is a centre for grain, potatoes, cattle, beekeeping products, etc., but is liable to occasional severe floods. Near it are *tumuli* of the Li-Kitai and statues 7 to 9 ft. high, covered with hieroglyphs. Abakansk had in 1939 a population of 13,500.

**ABALONE** (a Spanish word of unknown derivation), the name given in California to various species of molluscs of the widely distributed genus *Haliotis* ("ear shells," Ormers). The shell of these animals yields mother-of-pearl and is used in button-making and inlaying. The abalone was a favourite article of food among the Indians of California, and is still eaten there as well as in Japan and China. The Californian abalone is represented by various species; *Haliotis splendens, H. rufescens* and *H. cracherodii* are the most important ones. (*See* ORMER.)

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**ABANA** (or, as indicated to be read in the Hebrew text, *Amana,* classical *Chrysorrhoas*) and PHARPAR (Heb. *Parpar*) the "rivers of Damascus" (II Ki. v, 12). They are commonly identified with the two most important rivers of the district, the Barada, flowing through Damascus from its source in the Anti-Lebanon, and the 'Awaj, some 8 mi. S. of Damascus with its source in the Hermon range. The size of the rivers was probably of less moment than the sacredness of their waters. Abana (or Amana) may well be the Barada. A tributary, the Nahr Banias, perhaps retains an echo of the name. North of the 'Awaj is the independent Barbar in which we seem to have the name Pharpar. All the rivers of the district are either entirely dissipated in irrigation or eventually lose themselves in marshes to the east.

**ABANCOURT, CHARLES XAVIER JOSEPH DE FRANQUEVILLE D'** (1758–1792), French statesman, was Louis XVI's last minister of war (July 1792), and organized the defense of the Tuileries for Aug. 10. He was arrested for treason to the nation and sent to Orléans to be tried. At the end of August the assembly ordered Abancourt and the other prisoners at Orléans to be transferred to Paris. At Versailles the escort learned of the massacres at Paris, and Abancourt and his fellow-prisoners were murdered on Sept. 8, 1792.

**ABANDONMENT,** in law, the relinquishment of an interest, claim, privilege or possession. Its signification varies according to the branch of the law in which it is employed, but the more important uses of the word are summarized below.

ABANDONMENT OF AN ACTION is the discontinuance of proceedings commenced in the High Court of Justice either because

the plaintiff is convinced that he will not succeed in his action or for other reasons.

Previous to the Judicature act of 1875, considerable latitude was allowed as to the time when a suitor might abandon his action, and yet preserve his right to bring another action on the same suit; but since 1875 this right has been considerably curtailed, and a plaintiff who has delivered his reply, and afterward wishes to abandon his action, can generally obtain leave so to do only on condition of bringing no further proceedings in the matter. (*See* PRACTICE AND PROCEDURE.)

ABANDONMENT IN MARINE INSURANCE is the surrender of the ship or goods insured to the insurers, in the case of a constructive total loss of the thing insured. For the requisites and effects of abandonment in this sense *see* MARINE INSURANCE.

For the *abandonment* of a child of any age, *see* the article CHILDREN: PROTECTIVE LAWS.

ABANDONMENT OF DOMICILE is the ceasing to reside permanently in a former domicile coupled with the intention of choosing a new domicile. The presumptions which will guide the court in deciding whether a former domicile has been abandoned or not must be inferred from the facts of each individual case. (*See* DOMICILE.)

ABANDONMENT OF AN EASEMENT is the relinquishment of some accommodation or right in another's land, such as right of way, free access of light and air, etc. (*See* EASEMENT.)

**ABANO, PIETRO D'** (*c.* 1250–*c.* 1316), known also as PETRUS DE APONO or APONENSIS, Italian physician and philosopher, was born at Abano in 1250 or 1246. After studying medicine and philosophy at Paris he practised at Padua. He was twice brought to trial by the Inquisition on a charge of practising magic; on the first occasion he was acquitted, and he died before the second trial was completed. His best known works, in which he advocates the systems of Averroes and other Arabian writers, are the *Conciliator differentiarum quae inter philosophos et medicos versantur* and *De venenis eorumque remediis.*

**ABANO TERME,** a town in the province of Padua, Italy, on the eastern slope of Monti Euganei, 6m. S.W. by rail of Padua. Pop. (1936) 1,232 (town), 7,062 (commune). Its popular hot springs and mud baths were known to the Romans as *Aponi fons* or *Aquae Patavinae.* Ancient remains have been found. The Italian *Comando Supremo* was fixed here from Jan. 1918 to the signing of the Armistice, Nov. 3, in the local Villa Giusti.

**ABANTES,** the traditional name of the ancient inhabitants of Euboea, to whom was also ascribed the building of the town of Abae in Phocis.

**ABARBANEL:** *see* ABRABANEL, ISAAC.

**ABASGIA:** *see* GEORGIA.

**ABATED,** an obsolescent technical term applied in masonry and metal work to portions sunk beneath the general surface, as in panels where the background is sunk so as to leave letters or ornament in relief.

**ABATEMENT,** a beating down or diminishing, a term used especially in various legal phrases.

**Abatement of a nuisance** is the remedy of destroying or removing, allowed by law to a person or public authority injured by a public nuisance, provided no breach of the peace is committed in doing so. In the case of private nuisances abatement is also allowed provided there be no breach of the peace, and no damage be occasioned beyond what the removal of the nuisance requires (*see* NUISANCE).

**Abatement of freehold** takes place where, after the death of the person last seized, a stranger enters upon lands before the entry of the heir or devisee, and keeps the latter out of possession. It differs from intrusion, which is a similar entry by a stranger on the death of a tenant for life, to the prejudice of the reversioner, or remainder man; and from disseisin, which is the forcible or fraudulent expulsion of a person seized of the freehold (*see* FREEHOLD).

**Abatement of debts and legacies.**—When the assets of a deceased person are not sufficient to satisfy fully all the various creditors, their debts must abate proportionately, and they must accept a dividend. Also, in the case of legacies, when the funds or assets out of which they are payable are not sufficient to pay them in full, the legacies abate in proportion, unless there is a priority given specially to any particular legacy (*see* LEGACY). Annuities are subject to the same rule as general legacies

**Abatement in pleading,** or plea in abatement, was directed to defeating or quashing a particular action by some matter, such as a defect in form or the personal incompetency of the parties suing, pleaded by the defendant. All pleas in abatement are now abolished (Rules of the Supreme Court Order 21) In criminal proceedings the plea in abatement was nullified by the Criminal Law act, 1826, which required the court to amend according to the truth, and the Criminal Procedure act, 1851, which rendered description of the defendant unnecessary.

**Abatement in litigation.**—In civil proceedings no action abates by reason of the marriage, death or [illegible] of any of the parties, if the cause of action survives or continues, and does not become defective by the assignment, creation or devolution of any estate or title *pendente lite* (R.S.C. Order 17). Criminal proceedings do not abate on the death of the prosecutor, being in theory instituted by the Crown, but the Crown itself may bring about their termination without any decision on the merits and without the assent of the prosecutor.

**Abatement in heraldry** is a badge in coat-armour, indicating degradation or dishonour. It is called also *rebatement.*

**Abatement in taxation.**—A reduction in assessment to taxation or in rate of tax, which is made to remove anomalies, mitigate hardship or refine a scale of duties. Abatements have long been a special feature of the British income-tax system For many years a rough-and-ready graduated income-tax was formed by imposing a fixed poundage rate upon all incomes of whatever size, and providing in the Finance Act for (1) the total exemption of very small incomes and (2) the reduction or "abatement" of the assessments made upon incomes above the exemption limit and not exceeding certain moderate amounts. This abatement system has been swept away, but abatements of assessment to mitigate rate of tax are still made in respect of the maintenance of wife and young children and the payment of a life insurance premium. (*See* INCOME TAX.) In the United States abatement of State and local taxation is governed solely by statute, and the laws of the various States and the court decisions thereunder should therefore be consulted for specific information. Abatement of Federal taxation is also purely statutory; and the question is governed exclusively by numerous Acts of Congress, including Sec. 3220 of the Revised Statutes (as amended) and the various Federal revenue acts together with the regulations thereon. (*See* TAXATION.)

**ABATI** (ah-bah'tē), **NICCOLO** or DELL' ABBATO (1512–1571), a celebrated fresco-painter of Modena, whose best works are there and at Bologna. He accompanied Primaticcio to France, and assisted in decorating the palace at Fontainebleau (1552–71). A fine example of his work, representing the martyrdom of St. Peter and St. Paul, is in the Dresden Gallery.

**ABATIS,** ABATTIS or ABBATTIS (a French word meaning a heap of material thrown), a term in field fortification for an obstacle formed of the branches of trees laid in a row, with the tops directed towards the enemy and interlaced or tied with wire. The abatis is used alone or in combination with wire-entanglements and other obstacles.

**"A" BATTERY,** a battery which provides heating current for the filament of a vacuum tube (*see* ELECTRON TUBE).

**ABATTOIR:** *see* SLAUGHTERHOUSE.

**ABAUZIT** (ah-bō-zē), **FIRMIN** (1679–1767), French scholar, was born of Protestant parents at Uzès, in Languedoc, Nov. 11, 1679, and died at Geneva, March 20, 1767. After the revocation of the Edict of Nantes in 1685 his family took refuge in Geneva, where he received his education. Abauzit visited Holland and England, and was one of the earliest defenders of the discoveries of Sir Isaac Newton. He declined an offer from William III to settle in England, also the offer of the chair of philosophy at Geneva. A sinecure as librarian to the city of Geneva gave him leisure to pursue his multifarious studies. J. J. Rousseau praises him in *Nouvelle Héloïse,* and Voltaire, when a visitor said he had come to see a great man, asked if he

had seen Abauzit. A collection of his writings was published at Geneva in 1770, and another in London in 1773.

Information regarding Abauzit will be found in J Senebier's *Histoire littéraire de Genève,* Harwood's *Miscellanies* and W. Orme's *Bibliotheca Biblica* (1824).

**'ABBA 'ARIKA,** the name of the Babylonian *'amora* of the 3rd century, who established at Sura the systematic study of the Rabbinic traditions which, using the Mishnah as text, led to the compilation of the Talmud. He is commonly known as Rab.

**ABBADIDES,** a Mohammedan dynasty which arose in Spain on the downfall of the western caliphate. The founder of the house was Abu'l-Qāsim Mohammed, the cadi of Seville in 1023. When he died in 1042, he had created a state which, though weak in itself, was strong as compared with the little powers about it. He had made his family the recognized leaders of the Mohammedans of Arab and native Spanish descent against the Berber element, whose chief was the king of Granada. Abbad, surnamed al-Motaḍid, his son and successor, is one of the most remarkable figures in Spanish Mohammedan history. A poet and a lover of letters, he was also a poisoner, a drinker of wine, a sceptic and treacherous to the utmost degree. He killed with his own hand one of his sons who had rebelled against him. On one occasion he trapped a number of his enemies, the Berber chiefs of the Ronda, into visiting him in the Alcazar at Seville and got rid of them by smothering them in the hot room of a bath. It was his taste to preserve the skulls of the enemies he had killed—those of the poorer men to be used as flowerpots, while those of the princes were kept in special chests. His reign until his death on Feb. 28, 1069, was mainly spent in extending his power at the expense of his smaller neighbours and in conflicts with his chief rival, the king of Granada. After 1063 he was assailed by Ferdinand the Great of Castile and Leon, who marched to the gates of Seville and forced him to pay tribute. His son, Mohammed Abu'l-Qāsim—who reigned by the title of al-Motamid—was the third and last of the Abbadides. He went further in patronage of literature than his father, for he chose as his favourite and prime minister the poet Ibn Ammar. He carried on the feuds of his family with the Berbers and in his efforts to extend his dominions could be as faithless as his father. In 1080 he brought down upon himself the vengeance of Alphonso VI of Castile by a typical piece of flighty oriental barbarity. He had endeavoured to pay part of his tribute to the Christian king with false money. The fraud was detected by a Jew, who was one of the envoys of Alphonso. Al-Motamid, in a moment of folly and rage, crucified the Jew and imprisoned the Christian members of the mission. Alphonso retaliated by a destructive raid. When Alphonso took Toledo in 1085, al-Motamid called in Yusuf ibn Tashfin, the Almoravide (*see* SPAIN: *History* and ALMORAVIDES). During the six years which preceded his deposition in 1091, al-Motamid behaved with valour on the field, but with much meanness and political folly. It was probably during this period that he surrendered his beautiful daughter Zaida to the Christian king, who made her his concubine and is said by some authorities to have married her after she bore him a son, Sancho. In 1091 the Almoravides stormed Seville. Al-Motamid, who had fought bravely, was weak enough to order his sons to surrender the fortresses they still held, in order to save his own life. He died in prison in Africa in 1095.

*See* R. P. A. Dozy, *Histoire des Musulmans d'Espagne* (Leyden, 1861; 2nd ed., 1932); and *Historia Abbadidarum* (*Scriptorum Arabum loci de Abbadidis,* Leyden, 1846). (D. H.)

**ABBADIE, ANTOINE THOMSON D'** (1810–1897), and **ARNAUD MICHEL D'** (1815–1893), travellers, were born in Dublin, of a French father and an Irish mother. The parents moved to France in 1818. In 1835 the French academy sent Antoine on a scientific mission to Brazil, the results being published in 1873 under the title of *Observations Relatives à la physique du globe faites au Brésil et en Éthiopie.* The younger Abbadie spent some time in Algeria before the two brothers started for Abyssinia in 1837, landing at Massawa in Feb. 1838. After collecting much information on the geography, geology, archaeology and natural history of Abyssinia, the brothers returned to France in 1848. The younger brother, Arnaud, paid another visit to Abyssinia in 1853. Antoine became involved in various controversies relating both to his geographical results and his political activities in Abyssinia. Time and the investigations of subsequent explorers have shown that Abbadie was quite trustworthy as to his facts, though wrong in his contention that the Blue Nile was the main stream. The topographical results of his explorations were published in Paris in 1860–73 in *Géodésie de l'Éthiopie.* Of the *Géographie de l'Éthiopie* (1890) only one volume has been published. *Un Catalogue raisonné de manuscrits éthiopiens* (1859) contains a description of 234 Ethiopian manuscripts collected by Antoine. He published numerous papers dealing with the geography of Abyssinia, Ethiopian coins and ancient inscriptions. His *Reconnaissances magnétiques* (1890) is an account of the magnetic observations made by him in the course of several journeys to the Red sea and the Levant.

The general account of the travels of the two brothers was published by Arnaud in 1868 under the title of *Douze ans dans la Haute-Éthiopie.* Antoine died in 1897 and bequeathed an estate in the Pyrenees, yielding 40,000 francs a year, to the Academy of Sciences, on condition of its producing within 50 years a catalogue of 500,000 stars. His brother Arnaud died in 1893.

**'ABBAHU,** the name of a Palestinian rabbi who flourished *c.* 279–320. 'Abbahu encouraged the study of Greek by Jews. He is very often cited in the Talmud.

**ABBA MARI** (in full, Abba Mari ben Moses ben Joseph), French rabbi, was born at Lunel, near Montpellier, toward the end of the 13th century. He is also known as Yarhi from his birthplace (Heb. *Yerah; i.e.,* "moon," *lune*), and he further took the name Astruc, Don Astruc or En Astruc of Lunel. In Montpellier, where he lived from 1303 to 1306, he was much distressed by the prevalence of Aristotelian rationalism, which, through the medium of the works of Maimonides, threatened the authority of the Old Testament, obedience to the law, and the belief in miracles and revelation. He, therefore, in a series of letters (afterward collected under the title *Minhat Kenaot; i.e.,* "Jealousy Offering") called upon the famous rabbi Solomon ben Adret of Barcelona to come to the aid of orthodoxy. Ben Adret, with the approval of other prominent Spanish rabbis, sent a letter to the community at Montpellier proposing to forbid the study of philosophy to those who were less than 30 years of age, and, in spite of keen opposition from the liberal section, a decree in this sense was issued by Ben Adret in 1305. The result was a great schism among the Jews of Spain and southern France, and a new impulse was given to the study of philosophy by the unauthorized interference of the Spanish rabbis. On the expulsion of the Jews from France by Philip IV in 1306, Abba Mari settled at Perpignan, where he published the letters connected with the controversy.

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**'ABBĀS I** (1571–1629), shah of Persia, called the Great, was the son of Shah Mohammed Khudābanda (d. 1595). In 1581 he was proclaimed ruler of Khurāsān, and became shah in 1587 on his father's abdication. Confronted with anarchy in Persia and foreign invasion, he made peace with Turkey, subdued the rebels and attacked the Uzbegs, who were ravaging Khurāsān. In 1598 he regained Meshed, and shortly afterward defeated and expelled the Uzbegs. Three years later he reopened the war with Turkey, and in a series of campaigns in the northwest regained Tabriz (1604) and most of the Caucasian territories surrendered by the earlier treaty, including Georgia and Shirvan. The war continued, with intervals, to the end of his reign; in 1623 his troops occupied Baghdad, but failed to hold Mosul or to seize Basra. In 1622, with the aid of the English East India company, he expelled the Portuguese from the island of Hormuz, and much of its trade was diverted to Gombroon, renamed Bandar 'Abbās after him.

The military successes of Shah 'Abbās were largely the result of his reorganization of the army. In place of the tribal levies he created a regular force, thus not only gaining in efficiency but also reducing his dependence on the great nobles and tribal chiefs. An Englishman Sir Robert Sherley greatly improved the Persian

artillery. 'Abbās' reign was distinguished not only by military successes and administrative efficiency but also by the magnificence of his court and the splendid buildings that he erected, notably at his capital, Isfahan. He fostered industry and commerce by constructing highways, bridges and caravanserais, by granting privileges to his Armenian subjects and by encouraging the English and Dutch East India companies to trade in Persia. In religious matters he was generally tolerant. His fame was, however, tarnished by deeds of tyranny and cruelty: he put his eldest son to death and blinded another.

*See* L. L. Bellan, *Chah Abbas I, sa vie, son histoire* (Paris, 1932); Sir Edward Denison Ross (ed.), *Sir Anthony Sherley and His Persian Adventure* (London, 1933). (L. Lo.)

**ABBAS I** (1813–1854), pasha of Egypt, was a son of Tusun Pasha and grandson of Mohammed Ali. As a young man he fought in Syria under Ibrahim Pasha (*q.v.*), his real or supposed uncle. The death of Ibrahim in Nov. 1848 made Abbas regent of Egypt, and in Aug. 1849, just before the death of Mohammed Ali, he succeeded to the pashalik. He was reactionary, cruel, morose and taciturn and spent nearly all his time shut up in his palace. He undid, as far as he could, the works of his grandfather, good and bad. Among other things, he abolished trade monopolies, closed factories and schools and reduced the army to 9,000 men. At the instance of the British government he allowed the construction of a railway from Alexandria to Cairo. On July 13, 1854, he was murdered in Benha palace by two of his slaves.

**ABBAS II,** otherwise known as ABBAS HILMI PASHA (1874–1944), the last khedive of Egypt, was born in Cairo on July 14, 1874, and became the seventh ruler of the line of Mohammed Ali when he left his studies in Vienna to succeed his father, Tewfik Pasha, on Jan. 8, 1892. British official opinion attributed his marked Anglophobia to the early influence of his European education; but the tutelage of the British agent (the first Lord Cromer) was naturally galling, and there was already an incipient nationalism in Egypt. Abbas never came to good terms with the British although, after a visit to England in 1900, he declared himself ready to co-operate with them. He concerned himself with several matters of public interest; *e.g.*, irrigation, education and agriculture. But the attempt on his life by an Egyptian student in July 1914 during a visit to Constantinople suggests that he disappointed the nationalists. He was still in Constantinople when Turkey entered World War I; and his return was forbidden by the British, who declared a protectorate over Egypt and deposed him (Dec. 19, 1914). He was deprived of his estates in Egypt (though in Oct. 1930 he was granted a pension of £E30,000 a year). Having attempted, rather ineffectively, to collaborate with the Central Powers during World War I, he spent the remainder of his life in exile, chiefly in Switzerland. He died at Geneva on Dec. 21, 1944.

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**ABBASIDS,** the name generally given to the second of the two great dynasties of the Mohammedan empire (*see* CALIPHATE). The Abbasid caliphs based their claim on their descent from al-Abbas (566–652), son of 'Abd al-Muttalib, an uncle of Mohammed, and regarded themselves as the true heirs of the Prophet, as opposed to the descendants of his cousin Ali and the Omayyad caliphs of Damascus. In the first half of the 8th century they headed a propagandist movement which gained some success among the Arabs and Persians in Khurasan and broke into open rebellion in 747. The Khurasanian armies, marching westward, defeated the Omayyad caliph Marwan II on the Greater Zab in Jan. 750 and proclaimed Abu'l-Abbas, the great-grandson of al-Abbas, as caliph.

The new dynasty encouraged the development of commerce and the liberal arts. The reigns of Harun al-Rashīd (786–809) and al-Ma'mūn (813–33) at Baghdad were periods of extraordinary splendour. But the empire as a whole stagnated and then decayed: independent governors established themselves in Africa and Khurasan. The ruin of the dynasty came, however, from those Turkish slaves who were constituted as a royal bodyguard by al-Mu'tasim (833–42). After a century of fluctuating fortunes, the caliph Radi (934–41) and his successors were constrained to hand over most of the functions of government to the commanders of their armies. The dynasty lasted for another three centuries, but without exercising temporal power, until the Mongols under Hulagu captured Baghdad (Feb. 28, 1258). A branch of the family continued to maintain a feeble show of authority, confined to religious matters, in Egypt under the Mameluke sultans, but the dynasty finally disappeared when Mutawakkil III was taken to Constantinople as a prisoner by the Ottoman sultan Selim I (1517). (H. A. R. G.)

**'ABBAS MIRZA** (1783–1833), Persian prince, was a younger son of Feth Ali, shah of Persia, and was nominated to succeed him. But he predeceased his father and the succession fell to his son, Mohammed Mirza. 'Abbas Mirza conducted many campaigns against Russia between 1800 and 1813 when, by the treaty of Gulistan, Georgia and other provinces were ceded to Russia. In 1826–28 he and his son were again campaigning against Russia, again with no final success, for the khanates of Erivan and Nakhichevan were ceded to Russia. In the interval of the Russian wars he fought against the Turks, winning a complete victory near Erzerum in 1821. After the final peace with Russia 'Abbas Mirza set about the reorganization of the province of Khūrāsān and died at Meshed in Dec. 1833. Although 'Abbas was unsuccessful in the wars against Russia, he displayed great skill as a general, and learned something from the European soldiers who helped him to reorganize his army. He was cultured and intelligent and lived more simply than was the royal custom.

**ABBAS-TUMAN,** a spa in the Georgian S.S.R. (41° 44′ N., 42° 46′ E.). Its hot sulphur springs (93½°–118½° F.) and astronomical observatory (4,240 ft.) are noted. Population 1,243.

**ABBAYE,** the name given to a group of French writers, painters and musicians who, in 1906, formed a community at Créteil, where they set up a printing press and published their works. Their number included Roger Allard, René Arcos, Henri Barzun, Albert Doyen, Georges Duhamel, Jules Romains, Charles Vildrac, etc.

**ABBAZIA,** in the province of Fiume, Italy, 56 mi. S.E. of Trieste by rail. Pop. (1936), 5,605 (town), 8,642 (commune, which is called Volosca-Abbazia). It is on the Gulf of Quarnero at the foot of the Monte Maggiore (4,580 ft.), sheltered and surrounded by laurel woods. The average temperature is 50° F. (winter), and 77° F. (summer). The old abbey, San Giacomo al Palo, whence the town's name, is now a villa. Abbazia used to have 50,000 visitors each year. The whole seacoast to the north and south is rocky and picturesque.

**ABBE, CLEVELAND** (1838–1916), U.S. meteorologist and astronomer, was born in New York city on Dec. 3, 1838. His training as astronomer under B. A. Gould, Franz Brünnow and Friedrich Struve (Pulkova, 1865–66) and work at the U.S. naval observatory developed his interest in weather changes. As director of the Cincinnati, O., observatory, 1869–73, he demonstrated the practicability of weather forecasts based on daily telegraphic synoptic charts, and in 1870 joined the U.S. signal corps to organize and direct its weather forecasts. When this greatly expanded service was transferred to the department of agriculture in 1891, he went as senior professor of meteorology. Abbe was often and justly called the "father of the weather bureau." *The Monthly Weather Review,* which he edited, was due to his intiative, and he was influential in introducing the system of standard time.

Among his works are: *Report on Standard Time* (1879); *Mechanics of the Earth's Atmosphere* (1892–1910); *Preparatory Studies for Deductive Methods* (1890); *Relation between Climate and Crops* (1901); *Physical Basis of Long-range Forecasting* (1902).

**ABBE, ERNST** (1840–1905), German physicist, was born in Eisenach, Thuringia, Jan. 23, 1840. He was educated at Göttingen and Jena. In 1863 he became an instructor, and in 1870 was made a professor, in the University of Jena, at which in 1878 he was appointed director of the astronomical and meteorological observatories. In 1866 he became connected with the optical works of Carl Zeiss, was made a partner in 1875, and contributed in a very large degree through his experiments to the excellence of the instruments and lenses made by the firm. In 1884, with Zeiss

and Otto Schott, he established important works for the production of technical glass Upon the death of Zeiss in 1888 he became the sole owner of the Zeiss optical works, which he reorganized as a co-operative establishment; the officials, the workmen and the university [illegible] in its profits. He invented the Abbe refractometer [illegible] many improvements in microscopic and photographic lenses His *Gesammelte Abhandlungen* were published in 1903–06. He died in Jena, Jan 14, 1905.

*See* F Auersbach, *Ernst Abbe* (1918)

**ABBESS,** the superior of a community of nuns The mode of election, position, rights and authority of an abbess correspond generally with those of an abbot (*q v.*); but she cannot exercise priestly functions An abbess is elected by the secret votes of the sisters, installed solemnly by episcopal benediction, and has the abbatial cross, staff and ring; she holds office usually for life The Council of Trent fixed the qualifying age at 40, with 8 years of profession. In England abbesses attended ecclesiastical councils; *e.g.,* that of Becanfield in 694, where they signed before the presbyters. Abbesses presided over many of the early joint-houses of monks and nuns, *e g.,* at Whitby; and later the whole double order of Fontevraud (founded *c* 1100) was governed by an abbess In the German Evangelical Church the title of abbess (*Aebtissin*) has survived for the heads of abbeys which since the Reformation have continued as *Stifter; i e ,* collegiate foundations for the maintenance of unmarried women, generally of noble birth, called *Stiftsdamen*

**ABBEVILLE,** a city in the western part of South Carolina, U.S., 20 mi. from the Savannah river; the county seat of Abbeville county. It is served by the Seaboard railway. The population was 5,377 in 1950, 4,930 in 1940 and 4,414 in 1930 by the federal census. Cotton, tobacco and poultry are raised in the region, and clay is mined near the city. There are cotton mills in the city. Abbeville was settled about 1710 and incorporated in 1840.

**ABBEVILLE,** a town of northern France, the capital of an arrondissement, department of Somme, on the Somme, 12 mi from the English channel and 28 mi. N.W. of Amiens on the Northern railway. Pop. (1946) 16,780. It is built partly on an island and partly on both sides of the river, which is canalized from this point to the estuary. The tradition of settlement extends from the Palaeolithic through the late Bronze Age (when the area was very important).

Abbeville, chief town of Ponthieu, belonged in the 9th century to the abbey of St. Riquier, and afterward to the counts of Ponthieu It passed to the Alençon and other French families, and afterward to the house of Castille, from whom by marriage it went to Edward I of England. French and English ruled it by turns till 1435 when it was ceded to the duke of Burgundy. In 1477 it was annexed by Louis XI, and held by branches of the family until it was reunited to the crown in 1696. The streets are narrow and present an almost mediaeval appearance. The church of St. Vulfran, erected in the 15th, 16th and 17th centuries, was not entirely completed. The façade is a magnificent specimen of flamboyant Gothic flanked by two Gothic towers. Abbeville has other old churches and an hôtel de ville, with a belfry of the 13th century. Among the old houses, the Maison de François I dates from the 16th century. Situated on one of the main entries into France it became a great British base during World War I. Abbeville is an industrial centre; in addition to its old-established manufacture of cloth, hemp-spinning, sugar-making, shipbuilding and locksmiths' work are carried on; there is active commerce in grain, but the port has little trade. It has a tribunal of commerce and a board of trade-arbitrators.

**ABBEY, EDWIN AUSTIN** (1852–1911), U.S. painter, was born at Philadelphia April 1, 1852. He left the schools of the Pennsylvania Academy of Fine Arts at the age of 19 to enter the art department of the publishing house of Harper and Brothers in New York, where, in company with such men as Howard Pyle, Charles Stanley Reinhart, Joseph Pennell and Alfred Parsons, he became very successful as an illustrator. In 1878 he was sent by the Harpers to England to gather material for illustrations of the poems of Robert Herrick. These, published in 1882, attracted much attention, and were followed by illustrations for Goldsmith's *She Stoops to Conquer* (1887), for a volume of *Old Songs* (1889), and for the comedies (and a few of the tragedies) of Shakespeare. His water-colours and pastels were no less successful than the earlier illustrations in pen and ink. Abbey now became closely identified with the art life of England, and was elected to the Royal Institute of Painters in Water-Colours in 1883. Among his water-colours are "The Evil Eye" (1877); "The Rose in October" (1879); "An Old Song" (1886); "The Visitors" (1890), and "The Jongleur" (1892). Possibly his best-known pastels are "Beatrice," "Phyllis," and "Two Noble Kinsmen" In 1890 he made his first appearance with an oil painting, "A May Day Morn," at the Royal Academy in London. He exhibited "Richard duke of Gloucester and the Lady Anne" at the Royal Academy in 1896, and in that year was elected A R.A., becoming a full R.A. in 1898. Apart from his other paintings, special mention must be made of the large frescoes entitled "The Quest of the Holy Grail," in the Boston Public Library, on which he was occupied for some years; and in 1901 he was commissioned by King Edward VII to paint a picture of the coronation, containing many portraits elaborately grouped. The dramatic subjects, and the brilliant colouring of his oil pictures, gave them pronounced individuality among the works of contemporary painters. Abbey became a member not only of the Royal Academy, but also of the National Academy of Design of New York, and honorary member of the Royal Bavarian Society, the Société Nationale des Beaux Arts (Paris), the American Water-Colour Society, etc. He received first-class gold medals at the International Art Exhibition of Vienna in 1898, at Philadelphia in 1898, at the Paris Exhibitions of 1889 and 1900, and at Berlin in 1903; and was made a chevalier of the French Legion of Honour.

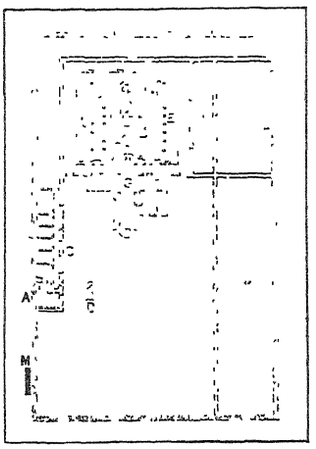
The last years of his life were devoted to mural paintings for the capitol at Harrisburg, Pa. Of these he undertook three, one for the House of Representatives, another for the Senate Chamber and the third for the ceiling of the dome. In 1910 there was completed under his supervision the decoration of the Peers' corridor of the Houses of Parliament at Westminster. He is represented by work at the Metropolitan Museum of Art in New York, the Boston Museum of Fine Arts and the National Gallery, London. He died in London on Aug. 1, 1911.

**ABBEY,** a monastery, or conventual establishment, under the government of an abbot or an abbess (Lat. *abbatia;* from Syr. *abba,* father).

The earliest Christian monastic communities (*see* MONASTICISM) with which we are acquainted consisted of groups of cells or huts collected about a common centre, which was usually the abode of some anchorite celebrated for superior holiness or singular asceticism. The formation of such communities in the East precedes Christianity, the example having been already set by the Essenes in Judea and the Therapeutae in Egypt.

In the earliest age of Christian monasticism the ascetics were accustomed to live singly, independent of one another, at no great distance from some village, supporting themselves by the labour of their own hands, and distributing to the poor the surplus after the supply of their own scanty wants. Increasing religious fervour, aided by persecution, drove them farther and farther away from the abodes of men into mountain solitudes or lonely deserts. The deserts of Egypt swarmed with the "cells" or huts of these anchorites. Anthony, who had retired to the Egyptian Thebaid during the persecution of Maximin, A.D. 312, was the most celebrated among them for his austerities, his sanctity, and his power as an exorcist. His fame collected round him a host of followers, emulous of his sanctity. The deeper he withdrew into the wilderness the more numerous his disciples became. They refused to be separated from him, and built their cells round that of their spiritual father. Thus arose the first monastic community, consisting of anchorites living each in his own little dwelling, united together under one superior. By degrees order was introduced in the groups of huts. They were arranged in lines like the tents in an encampment, or the houses in a street. From this arrangement these lines of single cells came to be known as

*Laurae*, Λαῦραι, "streets" or "lanes." The real founder of coenobian (κοινός, common, and βίος, life) monasteries in the modern sense was Pachomius, an Egyptian of the beginning of the 4th century. The first community established by him was at Tabennae, an island of the Nile in Upper Egypt Eight others were founded in his lifetime, numbering 3,000 monks Within 50 years from his death his societies could reckon 50,000 members. These coenobia resembled villages peopled by a hard-working religious community, all of one sex. The buildings were detached, small, and of the humblest character. The coenobia of Syria belonged to the Pachomian institution We learn many details concerning those in the vicinity of Antioch from Chrysostom's writings. The monks lived in separate huts, καλύβια, forming a religious hamlet on the mountain side. They were subject to an abbot, and observed a common rule. (They had no refectory, but ate their common meal, of bread and water only, when the day's labour was over, reclining on strewn grass, sometimes out of doors) Four times in the day they joined in prayers and psalms.



AFTER LENOIR

FIG. 1.—MONASTERY OF SANTA LAURA, MOUNT ATHOS. THE OLDER ABBEYS, CONSTRUCTED TO OFFER DEFENCE AGAINST ATTACKS, WERE BUILT WITH STRONG OUTER WALLS AND FEW ENTRANCES. SANTA LAURA HAD BUT TWO, THE MAIN ENTRANCE A AND THE POSTERN L

A. Gateway
B. Chapels
C. Guest house.
D. Church
E. Cloister
F. Fountain
G. Refectory
H. Kitchen
I. Cells
K. Storehouses
L. Postern gate
M. Tower

The necessity for defence from hostile attacks, economy of space, and convenience of access from one part of the community to another, by degrees dictated a more compact and orderly arrangement of the buildings of a monastic coenobium. Large piles of building were erected, with strong outside walls, capable of resisting the assaults of an enemy, within which all the necessary edifices were ranged round one or more open courts, usually surrounded with cloisters. The usual Eastern arrangement is exemplified in the plan of the convent of Santa Laura, Mount Athos (*Laura*, the designation of a monastery generally, being converted into a female saint).

This monastery, like the oriental monasteries generally, is surrounded by a strong and lofty blank stone wall, enclosing an area of between 3 and 4 acres. The longer side extends to a length of about 500ft. There is only one main entrance, on the north side (A), defended by three separate iron doors. Near the entrance is a large tower (M), a constant feature in the monasteries of the Levant. There is a small postern gate at L. The *enceinte* comprises two large open courts, surrounded with buildings connected with cloister galleries of wood or stone. The outer court, which is much the larger, contains the granaries and storehouses (K), and the kitchen (H) and other offices connected with the refectory (G). Immediately adjacent to the gateway is a two-storied guest-house, opening from a cloister (C). The inner court is surrounded by a cloister (EE), from which open the monks' cells (II). In the centre of this court stands the catholicon or conventual church, a square building with an apse of the cruciform domical Byzantine type. In front of the church stands a marble fountain (F), covered by a dome supported on columns. Opening from the western side of the cloister, but actually standing in the outer court, is the refectory (G), a large cruciform building, about 100ft. each way, decorated within with frescoes of saints. At the upper end is a semi-circular recess, in which is placed the seat of the *hegumenos* or abbot. This apartment is chiefly used as a hall of meeting, the oriental monks usually taking their meals in their separate cells.

**Benedictine.**—Monasticism in the West owes its extension and development to Benedict of Nursia (born A.D. 480). His rule was diffused with miraculous rapidity from the parent foundation on Monte Cassino through the whole of western Europe, and every country witnessed the erection of monasteries far exceeding anything that had yet been seen in spaciousness and splendour Few great towns in Italy were without their Benedictine convent, and they quickly rose in all the great centres of population in England, France, and Spain. The number of these monasteries founded between A.D. 520 and 700 is amazing. Before the Council of Constance, A.D 1415, no fewer than 15,070 abbeys had been established of this order alone. The buildings of a Benedictine abbey were uniformly arranged after one plan, modified where necessary (as at Durham and Worcester, where the monasteries stand close to the steep bank of a river) to accommodate the arrangement to local circumstances (*see* BENEDICTINES). We have no existing examples of the earlier monasteries of the Benedictine order. But we have fortunately preserved to us an elaborate plan of the great Swiss monastery of St. Gall, erected about A.D. 820, which puts us in possession of the whole arrangements of a monastery of the first class towards the early part of the 9th century. This curious and interesting plan has been made the

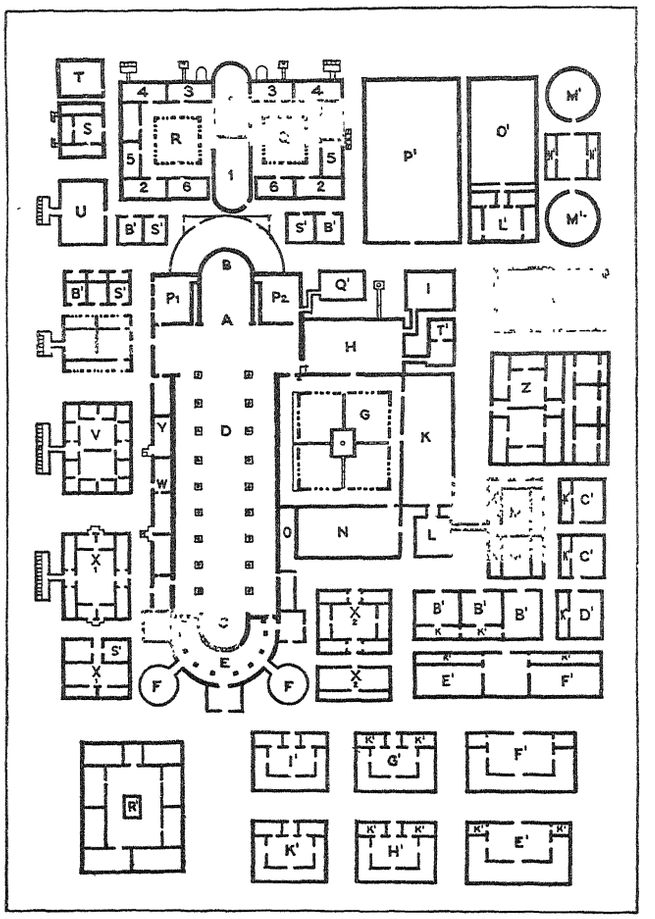


FIG. 2.—GROUND PLAN OF THE ABBEY OF ST. GALL, BUILT A.D. 820. THIS ABBEY FOLLOWED THE BENEDICTINE RULE OF BEING SELF-CONTAINED, AND HAD ITS OWN MILL AND BAKEHOUSE, TOGETHER WITH ACCOMMODATION FOR CARRYING ON ALL NECESSARY MECHANICAL ARTS

CHURCH: A. High Altar. B. Altar of St. Paul. C. Altar of St. Peter. D. Nave. E. Paradise. FF. Towers.
MONASTIC BUILDINGS: G. Cloister. H. Calefactory with dormitory situated above. I. Necessary. K. Refectory. L. Kitchen. M. Bakehouse and Brewhouse. N. Cellar. O. Parlour. P1. Scriptorium, with library over. P2. Sacristy and vestry. Q. House of novices: 1. Chapel. 2. Refectory. 3. Calefactory. 4. Dormitory. 5. Master's room. 6. Chambers. R. Infirmary: 1-6 as above in house of novices. S. Doctor's house. T. Physic garden. U. House for bloodletting. V. School. W. Schoolmaster's lodgings. $X_1X_1$. Guest-house for those of superior rank. $X_2X_2$. Guest-house for the poor. Y. Guest-chamber for strange monks.
MENIAL DEPARTMENT: Z. Factory. A'. Threshing-floor. B'. Work-shops. C'. Mills. D'. Kiln. E'. Stables. F'. Cowsheds. G'. Goatsheds. H'. Pigsties. I'. Sheep-folds. K'. Servants' and workmen's sleeping-chambers. L'. Gardener's house. M'. Hen and duck house. N'. Poultry-keeper's house. O'. Garden. P'. Cemetery. Q'. Bakehouse for sacramental bread. R'. Unnamed on plan. S'. Kitchens. T'. Baths

subject of a memoir both by Keller (Zürich, 1844) and by Professor Robert Willis (*Arch. Journal*, 1848, vol. v, pp. 86–117). To the latter we are indebted for the substance of the following description, as well as for the plan, reduced from his elucidated transcript of the original preserved in the archives of the convent The general appearance of the convent is that of a town of isolated houses with streets running between them. It is evidently planned in compliance with the Benedictine rule, which enjoined that, if possible, the monastery should contain within itself every necessary of life, as well as the buildings more intimately connected with the religious and social life of its inmates. It should comprise a mill, a bakehouse, stables, and cow-houses, together with accommodation for carrying on all necessary mechanical arts within the walls, so as to obviate the necessity of the monks going outside its limits.

The general distribution of the buildings may be thus described. The church, with its cloister to the south, occupies the centre of a quadrangular area, about 430ft. square. The buildings, as in all great monasteries, are distributed into groups. The church forms the nucleus, as the centre of the religious life of the community. In closest connection with the church is the group of buildings appropriated to the monastic life and its daily requirements—the refectory for eating, the dormitory for sleeping, the common room for social intercourse, the chapter-house for religious and disciplinary conference. These essential elements of monastic life are ranged about a cloister court, surrounded by a covered arcade, affording communication sheltered from the elements between the various buildings. The infirmary for sick monks, with the physician's house and physic garden, lies to the east. In the same group with the infirmary is the school for the novices. The outer school, with its headmaster's house against the opposite wall of the church, stands outside the convent enclosure, in close proximity to the abbot's house, that he might have a constant eye over them. The buildings devoted to hospitality are divided into three groups—one for the reception of distinguished guests, another for monks visiting the monastery, a third for poor travellers and pilgrims. The first and third are placed to the right and left of the common entrance of the monastery—the hospitium for distinguished guests being placed on the north side of the church, not far from the abbot's house; that for the poor on the south side next to the farm buildings. The monks are lodged in a guest-house built against the north wall of the church. The group of buildings connected with the material wants of the establishment is placed to the south and west of the church, and is distinctly separated from the monastic buildings. The kitchen, buttery, and offices are reached by a passage from the west end of the refectory and connected with the bakehouse and brewhouse, which are placed still farther away. The whole of the southern and western sides is devoted to workshops, stables and farm-buildings. The buildings, with some exceptions, seem to have been of one storey only, and all but the church were probably erected of wood.

**Canterbury Cathedral.**—A curious bird's-eye view of Canterbury cathedral and its annexed conventual buildings, taken about 1165, is preserved in the Great Psalter in the library of Trinity college, Cambridge. As elucidated by Prof. Willis,[1] it exhibits the plan of a great Benedictine monastery in the 12th century, and enables us to compare it with that of the 9th as seen at St. Gall. We see in both the same general principles of arrangement, which indeed belong to all Benedictine monasteries, enabling us to determine with precision the disposition of the various buildings, when little more than fragments of the walls exist. From some local reasons, however, the cloister and monastic buildings are placed on the north, instead, as is far more commonly the case, on the south of the church. There is also a separate chapter-house, which is wanting at St. Gall.

The buildings at Canterbury, as at St. Gall, form separate groups. The church forms the nucleus. In immediate contact with this, on the north side, lie the cloister and the group of buildings devoted to the monastic life. Outside of these, to the west and east, are the "halls and chambers devoted to the exercise of hospitality, with which every monastery was provided, for the purpose of receiving as guests persons who visited it, whether clergy or laity, travellers, pilgrims, or paupers." To the north a large open court divides the monastic from the menial buildings, intentionally placed as remote as possible from the conventual buildings proper, the stables, granaries, barn, bakehouse, brewhouse, laundries, etc., inhabited by the lay servants of the establishment. At the greatest possible distance from the church, beyond the precinct of the convent, is the eleemosynary department. The *almonry* for the relief of the poor, with a great hall annexed, forms the paupers' hospitium.

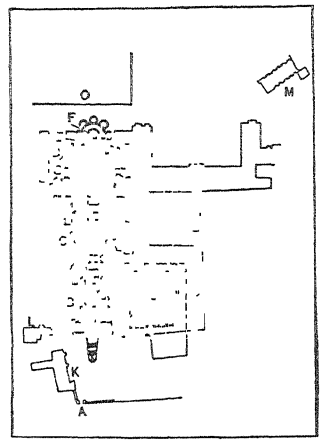



FIG 3.—PLAN OF ABBEY OF CLUNY, FRANCE AFTER VIOLLET-LE-DUC. CLUNY WAS THE MOST FAMOUS MONASTERY OF THE REFORMED ORDER OF BENEDICTINES. IT WAS SWEPT AWAY AT THE END OF THE 18TH CENTURY

| | |
|---|---|
| A. Gateway | H. Cloister |
| B. Narthex | K. Abbot's house. |
| C. Choir | L. Guest-house |
| D. High altar | M. Bakehouse |
| E. Retro-altar | N. Abbey buildings |
| F. Tomb of St. Hugh | O. Garden |
| G. Nave | P. Refectory |

**Westminster Abbey.**—Westminster abbey is another example of a great Benedictine abbey, identical in its general arrangements, so far as they can be traced, with those described above. The cloister and monastic buildings lay to the south side of the church. Parallel to the nave, on the south side of the cloister, was the refectory, with its lavatory at the door, and on the eastern side the remains of the dormitory, raised on a vaulted substructure and communicating with the south transept. The chapter-house opened out of the same alley of the cloister. The small cloister lay to the south-east of the larger cloister, and still farther to the east the remains of the infirmary with the *table hall*, the refectory of those who were able to leave their chambers. The abbot's house formed a small courtyard at the west entrance, close to the inner gateway. Considerable portions of this remain, including the abbot's parlour, celebrated as "the Jerusalem Chamber," his hall, now used for the Westminster king's scholars, and the kitchen and butteries beyond.

**Cluny.**—The history of monasticism is one of alternate periods of decay and revival. With growth in popular esteem came increase in material wealth, leading to luxury and worldliness. The first religious ardour cooled, the strictness of the rule was relaxed, until by the 10th century the decay of discipline was so complete in France that the monks are said to have been frequently unacquainted with the rule of St. Benedict, and even ignorant that they were bound by any rule at all. The reformation of abuses generally took the form of the establishment of new monastic orders, with new and more stringent rules, requiring a modification of the architectural arrangements. One of the earliest of these reformed orders was the *Cluniac*, taking its name from the little village of Cluny, 12m. N.W. of Mâcon, near which, about A.D. 909, a reformed Benedictine abbey was founded by William, duke of Aquitaine and count of Auvergne, under Berno, abbot of Beaume. He was succeeded by Odo, who is often regarded as the founder of the order. The fame of Cluny spread far and wide. Its rigid rule was adopted by a vast number of the old Benedictine abbeys, who placed themselves in affiliation to the mother society, while new foundations sprang up in large numbers, all owing allegiance to the "archabbot," established at Cluny. By the end of the 12th century the number of monasteries affiliated to Cluny in the various countries of western Europe amounted to 2,000. The monastic establishment of Cluny was one of the most extensive and magnificent in France. We may form some idea of its enormous dimensions from the fact recorded, that, when, A.D. 1245, Pope Innocent IV. accompanied

[1] *The Architectural History of the Conventual Buildings of the Monastery of Christ Church in Canterbury.* By the Rev. Robert Willis. Printed for the Kent Archaeological Society, 1869.

by twelve cardinals, a patriarch, three archbishops, the two generals of the Carthusians and Cistercians, the king (St. Louis), and three of his sons, the queen mother, Baldwin, count of Flanders and emperor of Constantinople, the duke of Burgundy, and six lords, visited the abbey, the whole party, with their attendants, were lodged within the monastery without disarranging the monks, 400 in number. Nearly the whole of the abbey buildings, including the magnificent church, were swept away at the close of the 18th century. When the annexed ground-plan was taken, shortly before its destruction, nearly all the monastery, with the exception of the church, had been rebuilt.

The church, the ground-plan of which bears a remarkable resemblance to that of Lincoln cathedral, was of vast dimensions. It was 656ft by 130ft. wide. The nave was 102ft and the aisles 60ft high. The nave (G) had double vaulted aisles on either side Like Lincoln, it had an eastern as well as a western transept, each furnished with apsidal chapels to the east. The western transept was 213ft. long, and the eastern 123ft. The choir terminated in a semicircular apse (F), surrounded by five chapels, also semicircular. The western entrance was approached by an ante-church, or *narthex* (B), itself an aisled church of no mean dimensions, flanked by two towers, rising from a flight of steps bearing a stone cross The first English house of the Cluniac order was that of Lewes, founded by the earl of Warren, *c.* AD 1077. Of this only a few fragments of the domestic buildings exist The best preserved Cluniac houses in England are Castle Acre, Norfolk, and Wenlock, Shropshire.

The Cluniac revival, with all its brilliancy, was but short-lived. The celebrity of this, as of other orders, worked its moral ruin. With their growth in wealth and dignity the Cluniac foundations became as worldly in life and as relaxed in discipline as their predecessors, and a fresh reform was needed.

**Cistercian.**—The next great monastic revival, the Cistercian, arising in the last years of the 11th century, had a wider diffusion, and a longer and more honourable existence. The rapid growth and wide celebrity of the order are undoubtedly to be attributed to the enthusiastic piety of St. Bernard, abbot of the first of the monastic colonies, subsequently sent forth in such quick succession by the first Cistercian houses, the far-famed abbey of Clairvaux, AD. 1116. The rigid self-abnegation, which was the ruling principle of this reformed congregation of the Benedictine order, extended itself to the churches and other buildings erected by them. The characteristic of the Cistercian abbeys was the extremest simplicity and a studied plainness. Only one tower—a central one—was permitted, and that was to be very low. Unnecessary pinnacles and turrets were prohibited. The windows were to be plain and undivided, and it was forbidden to decorate them with stained glass. All needless ornament was proscribed. The crosses must be of wood; the candlesticks of iron. The renunciation of the world was to be evidenced in all that met the eye. The same spirit manifested itself in the choice of the sites of their monasteries. The more dismal, the more hopeless a spot appeared, the more did it please their rigid mood But they came not merely as ascetics, but as improvers The Cistercian monasteries are, as a rule, found placed in deep well-watered valleys. They always stand on the border of a stream; not rarely, as at Fountains, the buildings extend over it. These valleys, now so rich and productive, wore a very different aspect when the brethren first chose them as the place of their retirement. Wide swamps, deep morasses, tangled thickets, wild impassable forests, were their prevailing features. The "bright valley," *Clara Vallis* of St. Bernard, was known as the "valley of Wormwood," infamous as a den of robbers.

All Cistercian monasteries, unless the circumstances of the locality forbade it, were arranged according to one plan. The general arrangement and distribution of the various buildings which went to make up one of these vast establishments may be gathered from that of St. Bernard's own abbey of Clairvaux, which is here given. It will be observed that the abbey precincts are surrounded by a strong wall, furnished at intervals with watch-towers and other defensive works. The wall is nearly encircled by a stream of water, artificially diverted from the small rivulets which flow through the precincts, furnishing the establishment with an abundant supply in every part, for the irrigation of the gardens and orchards, the sanitary requirements of the brotherhood and for the use of the offices and workshops.

The precincts are divided across the centre by a wall, running from north to south, into an outer and inner ward—the former containing the menial, the latter the monastic buildings. The pre-

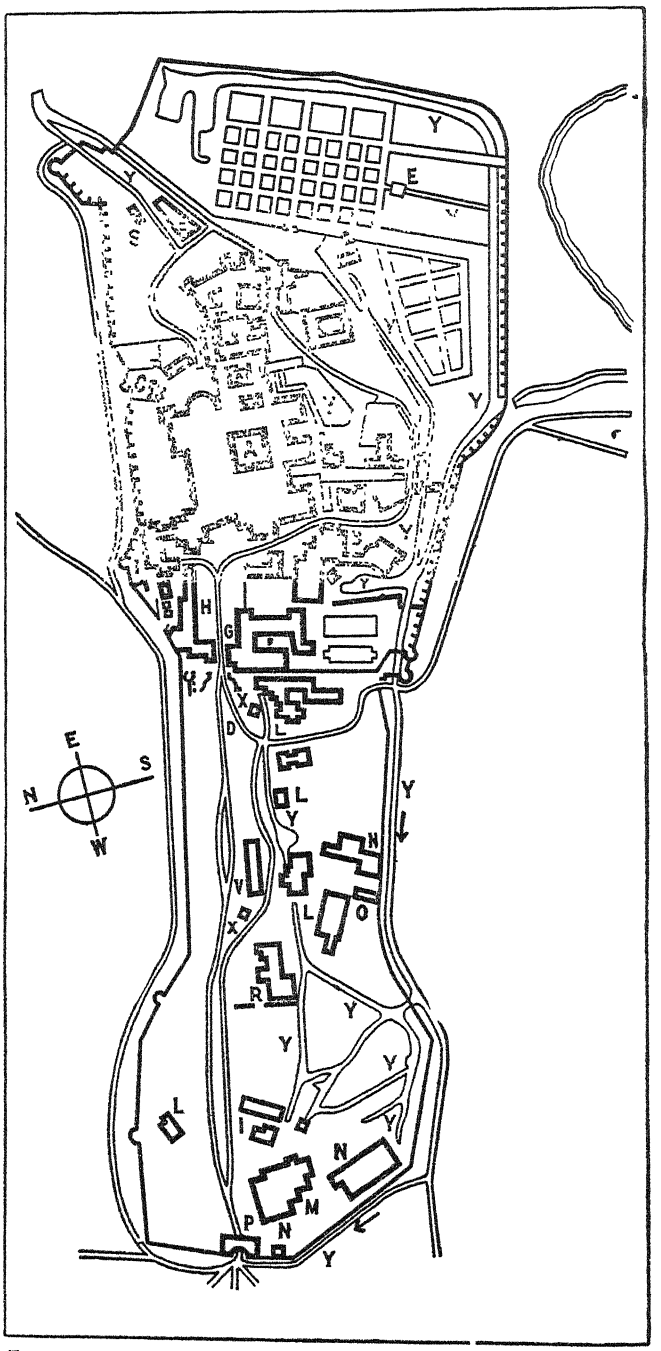



FIG. 4.—GENERAL PLAN OF CLAIRVAUX (CISTERCIAN). BUILT A D. 1116. THE CISTERCIANS WERE A REFORMED CONGREGATION OF THE BENEDICTINE ORDER. CISTERCIAN ABBEYS WERE NOTED FOR THEIR SIMPLICITY OF DESIGN

A. Cloisters
B. Ovens, and corn and oil mills
C. St. Bernard's cell
D. Chief entrance
E. Tanks for fish
F. Guest-house
G. Abbot's house
H. Stables
I. Wine-press and hay chamber
L. Workshops and workmen's lodgings
M. Slaughter-house
N. Barns and stables
O. Public presse
P. Gateway
R. Remains of old monastery
S. Oratory
V. Tile-works
X. Tile-kiln
Y. Water-courses

cincts are entered by a gateway (P), at the extreme western extremity, giving admission to the lower ward. Here the barns, granaries, stables, shambles, workshop and workmen's lodgings

were placed, without any regard to symmetry, convenience being the only consideration. Advancing eastwards, we have before us the wall separating the outer and inner ward, and the gate-house (D) affording communication between the two. On passing through the gateway, the outer court of the inner ward was entered, with the western façade of the monastic church in front. Immediately on the right of the entrance was the abbot's house (G), in close proximity to the guest-house (F). On the other side of the court were the stables, for the accommodation of the horses of the guests and their attendants (H). The church occupied a central position. To the south was the great cloister (A), surrounded by the chief monastic buildings, and farther to

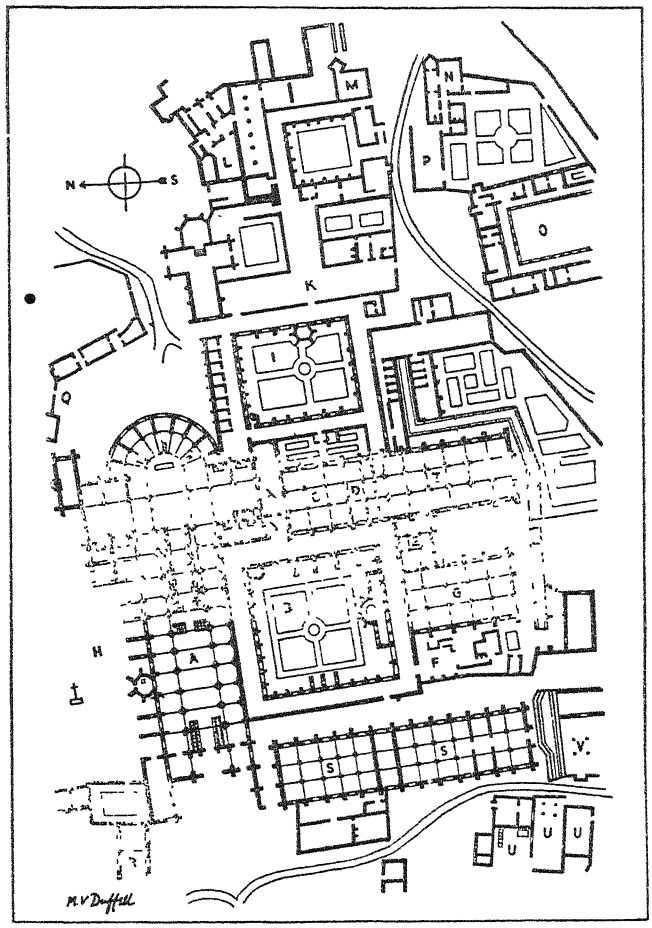



FIG. 5.—GENERAL PLAN OF THE MONASTIC BUILDINGS AT CLAIRVAUX. A WALL SEPARATED THE MONASTIC BUILDINGS OF CLAIRVAUX, HERE SHOWN ON A LARGER SCALE, FROM THE MENIAL DEPARTMENTS. THE POSITION OF THE REFECTORY IS USUALLY A MARKED POINT OF DIFFERENCE BETWEEN BENEDICTINE AND CISTERCIAN ABBEYS

A. Church
B. Cloister
C. Chapter-house
D. Monks' parlour
E. Calefactory
F. Kitchen and court
G. Refectory
H. Cemetery
I. Little cloister
K. Infirmary
L. Lodgings of novices
M. Old guest-house
N. Old abbot's lodgings
O. Cloister of supernumerary monks
P. Abbot's hall
Q. Cell of St. Bernard
R. Stables
S. Cellars and storehouses
T. Water-courses
U. Saw-mill and oil-mill
V. Currier's workshop
X. Sacristy
Y. Little library
Z. Undercroft of dormitory

the east the smaller cloister, opening out of which were the infirmary, novices' lodgings, and quarters for the aged monks. Still farther to the east, divided from the monastic buildings by a wall, were the vegetable gardens and orchards, and tank for fish. The large fish-ponds, an indispensable adjunct to any ecclesiastical foundation, on the formation of which the monks lavished extreme care and pains, and which often remain as almost the only visible traces of these vast establishments, were placed outside the abbey walls.

Figure 5 furnishes the ground-plan of the distinctly monastic buildings on a larger scale. The usually unvarying arrangement of the Cistercian houses allows us to accept this as a type of the monasteries of this order. The church (A) is the chief feature. It consists of a vast nave of eleven bays, entered by a narthex, with a transept and short apsidal choir. (It may be remarked that the eastern limb in all unaltered Cistercian churches is remarkably short, and usually square.) To the east of each limb of the transept are two square chapels, divided according to Cistercian rule by solid walls. Nine radiating chapels, similarly divided, surround the apse. The stalls of the monks, forming the ritual choir, occupy the four eastern bays of the nave. There was a second range of stalls in the extreme western bays of the nave for the *fratres conversi*, or lay brothers. To the south of the church, so as to secure as much sun as possible, the cloister was invariably placed, except when local reasons forbade it. Round the cloister (B) were ranged the buildings connected with the monks' daily life. The chapter-house (C) always opened out of the east walk of the cloister in a line with the south transept. In Cistercian houses this was quadrangular, and was divided by pillars and arches into two or three aisles. Between it and the transept we find the sacristy (X), and a small book-room (Y), *armariolum*, where the brothers deposited the volumes borrowed from the library. On the other side of the chapter-house, to the south, is a passage (D) communicating with the courts and buildings beyond. This was sometimes known as the *parlour, colloquii locus*, the monks having the privilege of conversation here. Here also, when discipline became relaxed, traders, who had the liberty of admission, were allowed to display their goods. Beyond this we often find the *calefactorium* or *day-room* —an apartment warmed by flues beneath the pavement, where the brethren, half frozen during the night offices, betook themselves after the conclusion of lauds, to gain a little warmth, grease their sandals and get themselves ready for the work of the day. In the plan before us this apartment (E) opens from the south cloister walk, adjoining the refectory. The place usually assigned to it is occupied by the vaulted substructure of the *dormitory* (Z). The *dormitory*, as a rule, was placed on the east side of the cloister, running over the *calefactory* and *chapter-house*, and joined the south transept, where a flight of steps admitted the brethren into the church for nocturnal services. Opening out of the dormitory was always the *necessarium*, planned with the greatest regard to health and cleanliness, a water-course invariably running from end to end. The refectory opens out of the south cloister at (G). The position of the refectory is usually a marked point of difference between Benedictine and Cistercian abbeys. In the former, as at Canterbury, the refectory ran east and west parallel to the nave of the church, on the side of the cloister farthest removed from it. In the Cistercian monasteries, to keep the noise and smell of dinner still farther away from the sacred building, the refectory was built north and south, at right angles to the axis of the church. It was often divided, sometimes into two, sometimes, as here, into three aisles. Outside the refectory door, in the cloister, was the *lavatory*, where the monks washed their hands at dinner-time. The buildings belonging to the material life of the monks lay near the refectory, as far as possible from the church, to the south-west. With a distinct entrance from the outer court was the kitchen court (F), with its buttery, scullery, and larder, and the important adjunct of a stream of running water. Farther to the west, projecting beyond the line of the west front of the church, were vast vaulted apartments (SS), serving as cellars and storehouses, above which was the dormitory of the *conversi*. Detached from these, and separated entirely from the monastic buildings, were various workshops, which convenience required to be banished to the outer precincts, a saw-mill and oil-mill (UU) turned by water, and a currier's shop (V), where the sandals and leathern girdles of the monks were made and repaired.

Returning to the cloister, a vaulted passage admitted to the small cloister (I), opening from the north side of which were eight small cells, assigned to the scribes employed in copying works for the library, which was placed in the upper story, accessible by a turret staircase. To the south of the small cloister a long hall will be noticed. This was a *lecture-hall*, or

rather a hall for the religious disputations customary among the Cistercians. From this cloister opened the *infirmary* (K), with its hall, chapel, cells, blood-letting house, and other dependencies. At the eastern verge of the vast group of buildings we find the *novices' lodgings* (L), with a third cloister near the novices' quarters and the original guest-house (M) Detached from the great mass of the monastic edifices was the original abbot's house (N), with its dining-hall (P). Closely adjoining this, so that the eye of the father of the whole establishment should be constantly over those who stood the most in need of his watchful care—those who were training for the monastic life, and those who had worn themselves out in its duties—was a fourth cloister (O), with annexed buildings, devoted to the aged and infirm members of the establishment. The cemetery, the last resting-place of the brethren, lay to the north side of the nave of the church (H).

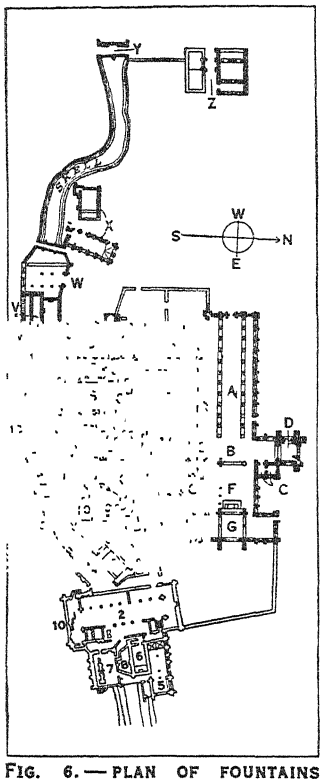



FIG. 6.—PLAN OF FOUNTAINS ABBEY, YORKSHIRE, FOUNDED A.D. 1132. ADDITIONS SHOWING A WIDE DEPARTURE FROM THE SIMPLICITY OF THE ORIGINAL FOUNDATIONS WERE MADE TO THE ABBEY IN SUCCEEDING CENTURIES UNTIL IT BECAME ONE OF THE MOST SPACIOUS IN ENGLAND

MONASTIC BUILDINGS: A. Nave of church. B. Transept. C. Chapels. D. Tower. E. Sacristy. F. Choir. G. Chapel of Nine Altars. H. Cloister. I. Chapter-house. K. Base court. L. Calefactory. M. Water-course. N. Cellar. O. Brewhouse. P. Prisons. Q. Kitchen. R. Offices. S. Refectory. T. Buttery. U. Cellars and storehouses. V. Necessary. W. Infirmary (?). X. Guest-houses. Y. Mill bridge. Z. Gate-house.

ABBOT'S HOUSE: 1. Passage. 2. Great hall. 3. Refectory. 4. Buttery. 5. Storehouse. 6. Chapel. 7. Kitchen. 8. Ashpit. 9. Yard. 10. Kitchen tank

It will be seen from the above account that the arrangement of a Cistercian monastery was in accordance with a clearly defined system, and admirably adapted to its purpose. The base court nearest to the outer wall contained the buildings belonging to the functions of the body as agriculturists and employers of labour. Advancing into the inner court, the buildings devoted to hospitality are found close to the entrance; while those connected with the supply of the material wants of the brethren—the kitchen, cellars, etc.—form a court of themselves outside the cloister and quite detached from the church. The church, refectory, dormitory and other buildings belonging to the professional life of the brethren, surround the great cloister. The small cloister beyond, with its scribes' cells, library, hall for disputations, etc., is the centre of the literary life of the community. The requirements of sickness and old age are carefully provided for in the infirmary cloister and that for the aged and infirm members of the establishment. The same group contains the quarters of the novices.

The English Cistercian houses, of which there are such extensive and beautiful remains at Fountains, Rievaulx, Kirkstall, Tintern, Netley, etc., were mainly arranged after the same plan, with slight local variations.

**Fountains Abbey.**—Fountains abbey, first founded A.D. 1132, is one of the largest and best preserved Cistercian houses in England. Earlier buildings received considerable additions and alterations in the later period of the order, causing deviations from the strict Cistercian type The church stands a short distance to the north of the River Skell, the buildings of the abbey stretching down to and even across the stream. We have the cloister (H) to the south, with the three-aisled chapter-house (I) and calefactory (L) opening from its eastern walk, and the refectory (S), with the kitchen (Q) and buttery (T) attached, at right angles to its southern walk. Parallel with the western walk is an immense vaulted substructure (U), incorrectly styled the cloisters, serving as cellars and store-rooms, and supporting the dormitory of the *conversi* above. This building extended across the river. At its south-west corner were the necessaries (V), also built, as usual, above the swiftly flowing stream. The monks' dormitory was in its usual position above the chapter-house, to the south of the transept. As peculiarities of arrangement may be noticed the position of the kitchen (Q), between the refectory and calefactory, and of the infirmary (W) (unless there is some error in its designation) above the river to the west, adjoining the guest-houses (XX). We may also call attention to the greatly lengthened choir, commenced by Abbot John of York, 1203–11, and carried on by his successor, terminating, like Durham cathedral, in an eastern transept, the work of Abbot John of Kent, 1220–47, and to the tower (D), added not long before the dissolution by Abbot Huby, 1494–1526, in a very unusual position at the northern end of the north transept. The abbot's house, the largest and most remarkable example of this class of buildings in the kingdom, stands south to the east of the church and cloister, from which it is divided by the kitchen court (K), surrounded by the ordinary domestic offices. A considerable portion of this house was erected on arches over the Skell. The size and character of this house, probably, at the time of its erection, the most spacious house of a subject in the kingdom, not a castle, bespeaks the wide departure of the Cistercian order from the stern simplicity of the original foundation. The hall (2) was one of the most spacious and magnificent apartments in mediaeval times, measuring 170ft. by 70ft. Like the hall in the castle at Winchester, and Westminster hall, as originally built, it was divided by 18 pillars and arches, with 3 aisles. Among other apartments, for the designation of which we must refer to the ground-plan was a domestic oratory or chapel, (6) 46½ft. by 23ft. and a kitchen (7), 50ft. by 38ft.

**Feudal Character.**—The arrangement of the building bespeaks the powerful feudal lord, not the humble father of a body of hard-working brethren, bound by vows to a life of poverty and self-denying toil. In the words of Dean Milman, "the superior, once a man bowed to the earth with humility, care-worn, pale, emaciated, with a coarse habit bound with a cord, with naked feet, had become an abbot on his curvetting palfrey, in rich attire, with his silver cross before him, travelling to take his place amid the lordliest of the realm." (*Lat. Christ.* vol. iii. p. 330.)

The buildings of the *Austin canons* or *Black canons* (so called from the colour of their habit) present few distinctive peculiarities. This order had its first seat in England at Colchester, where a house for Austin canons was founded about A.D. 1105, and it very soon spread widely. As an order of regular clergy, holding a middle position between monks and secular canons, almost resembling a community of parish priests living under rule, they adopted naves of great length to accommodate large congregations

The *Premonstratensian* regular canons, or White canons, had as many as 35 houses in England, of which the most perfect remaining are those of Easby, Yorkshire, and Bayham, Kent. The head house of the order in England was Welbeck. This order was a reformed branch of the Austin canons, founded, A.D. 1119, by Norbert (born at Xanten, on the Lower Rhine, *c.* 1080) at Prémontré, a secluded marshy valley in the forest of Coucy in the diocese of Laon. The order spread widely. Even in the founder's lifetime it possessed houses in Syria and Palestine. It long maintained its rigid austerity, till in the course of years wealth impaired its discipline, and its members sank into indolence and luxury. The Premonstratensians were brought to England shortly after A.D. 1140, and were first settled at Newhouse, in Lincolnshire, near the Humber. The ground-plan of Easby abbey, owing to its situation on the edge of the steeply-sloping banks of the Swale, is singularly irregular. The cloister is duly placed on the south side of the church, and the chief buildings occupy their usual positions round it. But the cloister garth, as at Chichester, is not rectangular, and all the surrounding buildings are thus made to sprawl in a very awkward fashion. The church

follows the plan adopted by the Austin canons in their northern abbeys, and has only one aisle to the nave—that to the north, while the choir is long, narrow and aisleless. Each transept has an aisle to the east, forming three chapels.

The church at Bayham was destitute of aisles either to nave or choir. The latter terminated in a three-sided apse. This church is remarkable for its exceeding narrowness in proportion to its length Extending in longitudinal dimensions 257ft., it is not more than 25ft broad. Stern Premonstratensian canons wanted

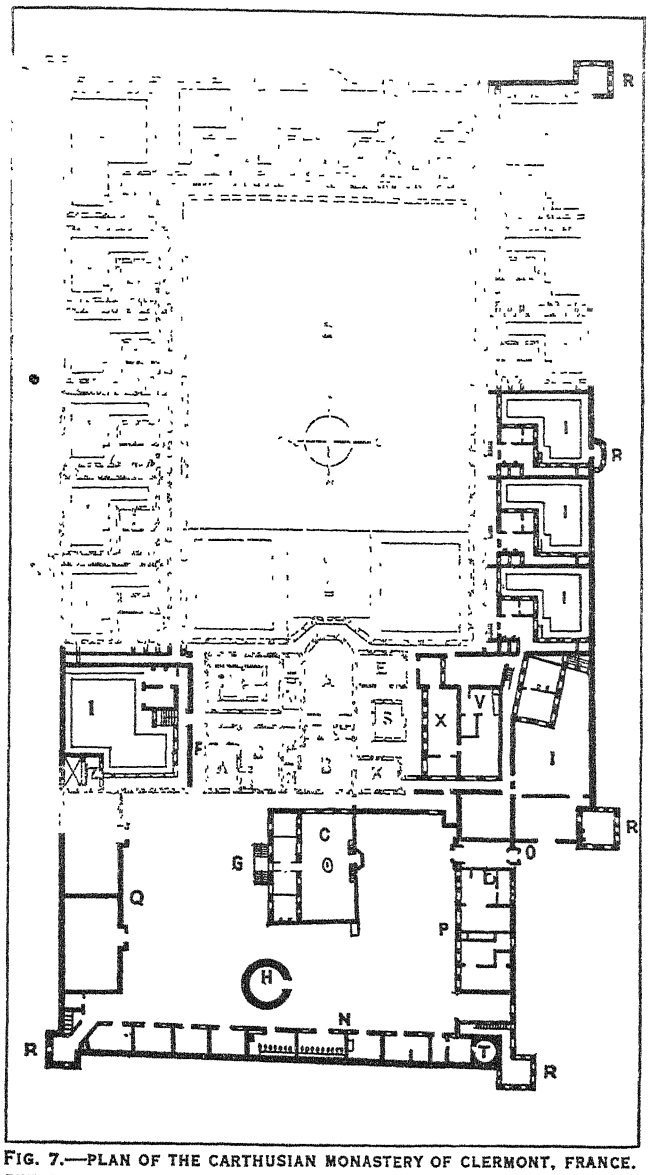



FIG. 7.—PLAN OF THE CARTHUSIAN MONASTERY OF CLERMONT, FRANCE. THE PRINCIPLES OF THE CARTHUSIAN ORDER DEMANDED A DISTINCT FORM OF MONASTIC INSTITUTION IN WHICH THE BROTHERHOOD COULD LIVE IN SOLITUDE AND SILENCE—HENCE THE SEPARATE CELLS

| | | |
|---|---|---|
| A. Church | K. Chapel of Pontgibaud | S. Little cloister |
| B. Monks' choir | L. Sacristy | T. Bakehouse |
| C. Prior's garden | M. Chapel | V. Kitchen |
| D. Great cloister | N. Stables | X. Refectory |
| E. Chapter-house | O. Gateway | Y. Cemetery |
| F. Passage | P. Guest-chambers | Z. Prison |
| G. Prior's lodgings | Q. Barns and granaries | A'. Cell of sub-prior |
| H. Dovecot | R. Watch-tower | B'. Garden of sub-prior |
| I. Cells | | |

no congregations, and cared for no possessions; therefore they built their church like a long room.

**Carthusians.**—The *Carthusian* order, on its establishment by St. Bruno, about A.D. 1084, developed a greatly modified form and arrangement of a monastic institution. The principle of this order, which combined the coenobitic with the solitary life, demanded the erection of buildings on a novel plan. This plan, which was first adopted by St. Bruno and his twelve companions at the original institution at Chartreux, near Grenoble, was maintained in all the Carthusian establishments throughout Europe, even after the ascetic severity of the order had been to some extent relaxed, and the primitive simplicity of their buildings had been exchanged for the magnificence of decoration which characterizes such foundations as the *Certosas* of Pavia and Florence. According to the rule of St. Bruno, all the members of a Carthusian brotherhood lived in the most absolute solitude and silence. Each occupied a small detached cottage, standing by itself in a small garden surrounded by high walls and connected by a common corridor or cloister. In these cottages or cells a Carthusian monk passed his time in the strictest asceticism, only leaving his solitary dwelling to attend the services of the Church, except on certain days when the brotherhood assembled in the refectory. The peculiarity of the arrangements of a Carthusian monastery, or *charter-house*, as it was called in England, from a corruption of the French *chartreux*, is exhibited in the plan of that of Clermont, after Viollet-le-Duc.

**Clermont Abbey** is surrounded by a wall, furnished at intervals with watch towers (R). The enclosure is divided into two courts, of which the eastern court, surrounded by a cloister, from which the cottages of the monks (I) open, is much the larger. The two courts are divided by the main buildings of the monastery, including the church, the sanctuary (A), divided from B, the monks' choir, by a screen with two altars, the smaller cloister to the south (S) surrounded by the chapter-house (E), the refectory (X)—these buildings occupying their normal position—and the chapel of Pontgibaud (K). The kitchen with its offices (V) lies behind the refectory, accessible from the outer court without entering the cloister. To the north of the church, beyond the sacristy (L), and the side chapels (M), we find the cell of the sub-prior (A') with its garden. The lodgings of the prior (G) occupy the centre of the outer court, immediately in front of the west door of the church, and face the gateway of the convent (O). A small raised court with a fountain (C) is before it. This outer court also contains the guest-chambers (P), the stables, and lodgings of the lay brothers (N), the barns and granaries (Q), the dovecot (H), and the bakehouse (T). At Z is the prison. (In this outer court, in all the earlier foundations, as at Witham, there was a smaller church in addition to the larger church of the monks ) The outer and inner courts are connected by a long passage (F), wide enough to admit a cart laden with wood to supply the cells of the brethren with fuel. The number of cells surrounding the great cloister is 18. They are all arranged on a uniform plan. Each little dwelling contains three rooms: a sitting room (C), warmed by a stove in winter; a sleeping-room (D), furnished with a bed, a table, a bench, and a book-case; and a closet (E). Between the cell and the cloister gallery (A) is a passage or corridor (B), cutting off the inmate of the cell from all sound or movement which might interrupt his meditations. The superior had free access to this corridor, and through open niches was able to inspect the garden without being seen. At I is the hatch or turn-table, in which the daily allowance of food was deposited by a brother appointed for that purpose, affording no view either inwards or outwards. H is the garden, cultivated by the occupant of the cell. At K is the wood-house. F is a covered walk, with the necessary at the end.

The above arrangements are found with scarcely any variation in all the charter-houses of western Europe. The Yorkshire Charter-house of Mount Grace, founded by Thomas Holland, the young duke of Surrey, nephew of Richard II. and marshal of England, during the revival of the popularity of the order, about A.D. 1397, is the most perfect and best preserved English example.

**Mendicant Friars.**—An article on monastic arrangements would be incomplete without some account of the convents of the Mendicant or Preaching Friars, including the Black Friars or Dominicans, the Grey or Franciscans, the White or Carmelites, the Eremite or Austin Friars. These orders arose at the beginning of the 13th century, when the Benedictines, together with their various reformed branches, had terminated their active mission, and Christian Europe was ready for a new religious

revival. Planting themselves, as a rule, in large towns, and by preference in the poorest and most densely populated districts, the Preaching Friars were obliged to adapt their buildings to the requirements of the site. Regularity of arrangement, therefore, was not possible, even if they had studied it. Their churches, built for the reception of large congregations of hearers rather than worshippers, form a class by themselves, totally unlike those of the elder orders in ground-plan and character They were usually long parallelograms unbroken by transepts. The nave very usually consisted of two equal bodies, one containing the stalls of the brotherhood, the other left entirely free for the congregation. The constructional choir is often wanting, the whole church forming one uninterrupted structure, with a continuous range of windows. Taken as a whole, the remains of the establishments of the friars afford little warrant for the invective of Matthew Paris, benedictine of St. Albans. "The friars who have been founded scarcely 40 years have built residences as the palaces of kings These are they who, enlarging day by day their sumptuous edifices and encircling them with lofty walls, lay up in them their incalculable treasures, transgressing the bounds of poverty and violating the fundamental rules of their profession"

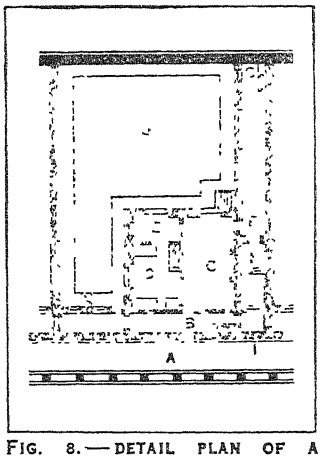


FIG. 8.—DETAIL PLAN OF A CARTHUSIAN CELL AT CLERMONT. THE GENERAL PLAN OF CLERMONT PROVIDES FOR SEPARATE CELLS FOR EACH MONK. THE ORDER WAS FOUNDED BY ST. BRUNO, 1084

A. Cloister gallery
B. Corridor
C. Living-room
D. Sleeping-room
E. Closet
F. Covered walk
G. Necessary
H. Garden
I. Hatch
K. Wood-house

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**ABBON OF FLEURY** or ABBO FLORIACENSIS (*c.* 945–1004), French scholar. He spent two years in England, and was abbot of Romsey. After his return to France he was made abbot of Fleury on the Loire (988). He was twice sent to Rome by King Robert the Pious (986–96), and on each occasion succeeded in warding off a threatened papal interdict. He was killed at La Réole in 1004, in endeavouring to quell a monkish revolt. He wrote an *Epitome de vitis Romanorum pontificum*, besides controversial treatises, letters, etc. (*see* Migne, *Patrologiae Latina*). His life, written by his disciple Aimoin of Fleury, in which much of Abbon's correspondence was reproduced, is of great importance as a source for the reign of Robert II., especially with reference to the papacy (*cf.* Migne, *op. cit.* vol. cxxxix.).

*See* Ch. Pfister, *Études sur le règne de Robert le Pieux* (1885); Cuissard-Gaucheron, "L'École de Fleury-sur-Loire à la fin du 10e siècle," in *Mémoires de la société archéol. de l'Orléanais*, xiv. (Orleans, 1875); A. Molinier, *Sources de l'histoire de France.*

**ABBOT, CHARLES GREELEY** (1872– ), American astrophysicist, was born in Wilton, N.H., on May 31, 1872. He graduated in 1894 from the Massachusetts Institute of Technology, and after a year of graduate study there joined the staff of the astrophysical observatory of the Smithsonian Institution. Here he served first as assistant, 1895–96, and then as acting director in charge from 1896 until 1907, when he was appointed director. He made original investigations in solar physics, studying especially the infra-red solar spectrum, the solar constant of radiation, the variability of solar and terrestrial temperatures and the utilization of solar heat. In connection with his researches he conducted expeditions to observe total eclipses of the sun in 1900, 1901, 1908 and 1919. In collaboration with S. P. Langley he completed the mapping of the infra-red spectrum, published in the *Annals* (vol. i.) of the astrophysical observatory. With F. E. Fowle and L. B Aldrich he published also in the *Annals* (vol iii, iv.) proofs of the variability of the sun, as shown by experiments conducted simultaneously in California and Algeria and from observations made in expeditions to Arizona and Chile. In recognition of his discoveries he was awarded the Draper medal (1910) and the Rumford medal (1916). To scientific journals he has contributed numerous articles on the apparatus, methods and results of solar research. He published *The Sun* (1907), *Everyday Mysteries* (1923) and *The Earth and the Stars* (1925 and 1946). In 1918 he was made assistant secretary, and from 1928 to 1944 was secretary, of the Smithsonian institution

**ABBOT, EZRA** (1819–1884), U.S. biblical scholar, was born at Jackson, Me., April 28, 1819. He graduated at Bowdoin college in 1840; and, after being principal of a public school in Cambridge, became assistant librarian of Harvard university, and from 1872 until his death Bussey Professor of New Testament Criticism and Interpretation in the Harvard divinity school. His studies were chiefly in oriental languages and the textual criticism of the New Testament, though he was a remarkable bibliographer. His publications were largely dispersed in the pages of reviews and other publications, but to the enlarged American edition of Smith's *Dictionary of the Bible* (1867–70), he contributed more than 400 articles besides greatly improving the bibliographical completeness of the work. His principal single production, representing his scholarly method and conservative conclusions, was *The Authorship of the Fourth Gospel* (1880; second edition, by J. H. Thayer, with other essays, 1889), up to that time probably the ablest defence, based on external evidence, of the Johannine authorship, and certainly the most complete treatment of the relation of Justin Martyr to this gospel. He died in Cambridge, Mass, March 21, 1884.

*See* S. J. Barrows, *Ezra Abbot* (1884).

**ABBOT, GEORGE** (1562–1633), Archbishop of Canterbury, was born on Oct. 19, 1562, at Guildford, Surrey, the son of a cloth-worker. Educated at Balliol College, Oxford, he became master of University College (1597) and dean of Winchester (1600).

He was one of those who prepared King James's Version of the Bible. James I. sent him to Scotland in 1608 to arrange for the establishment of episcopacy there. On his return he was preferred to the bishopric of Lichfield and Coventry (1609), London (1609) and Canterbury (1611). As vice-chancellor of the University of Oxford at different times between 1600 and 1605, he had come into conflict with Laud, and at court he supported Puritan measures. He promoted the marriage between the Elector Palatine and Princess Elizabeth, and resisted the proposal for the marriage of the Prince of Wales to the Spanish infanta.

Under Charles I. he was suspended from his functions of primate for refusing to license the Assize sermon preached by Robert Sibthorp at Northampton (Feb. 22, 1627), advocating non-resistance to the royal demands, however arbitrary. He died at Croydon, Aug. 5, 1633, and was buried at Guildford, where he had endowed a hospital. Abbot's later years were clouded by the fact that in 1622 he had accidentally shot a keeper while hunting. His enemies maintained that the homicide, though accidental, disqualified him from office, and the matter had to be referred to a commission, on which King James had to exercise his casting vote in the archbishop's favour.

**ABBOT, WILLIAM** (1798–1843), English actor, was born in Chelsea, and made his first appearance on the stage at Bath in 1806, and his first London appearance in 1808. He created the parts of Appius Claudius in Sheridan Knowles's *Virginius* (1820) and of Modus in his *Hunchback* (1832). In 1827 he organized the company, including Macready and Miss Smithson, which acted Shakespeare in Paris. Two of Abbot's melodramas, *The Youthful Days of Frederick the Great* (1817) and *Swedish Patriotism* (1819), were produced at Covent Garden. He died in poverty at Baltimore, Maryland.

**ABBOT,** the head and chief governor of a community of monks, called also in the East *hegumenos* or *archimandrite*. The title abbot is derived ultimately from the Hebrew *ab*, "father," through

the Syriac *abbas,* and had its origin in the monasteries of Syria, whence it spread through the East, and soon became accepted in all languages as the designation of the head of a monastery. But though general in the West, it was never universal. Among the Dominicans, Carmelites, Augustinians, etc., the superior was called *Prior;* among the Franciscans, *Custos* ("guardian").

In Egypt, the first home of monasticism, the abbot or archimandrite sometimes ruled over only one community, sometimes over several, each of which had its own abbot as well. By the rule of St. Benedict, which, until the reform of Cluny, governed monasticism in the West, the abbot has jurisdiction over only one community. The rule was subject to frequent violations; but it was not until the foundation of the Cluniac Order that the idea of a supreme abbot, exercising jurisdiction over all the houses of an order, was definitely recognized. New styles expressed this new relation; thus the abbot of Monte Cassino was called *abbas abbatum* ("abbot of abbots"), while the chiefs of other orders had the titles *abbas generalis* ("abbot general"), or *magister* ("master") or *minister generalis* ("minister general").

Monks, as a rule, were laymen, nor at the outset was the abbot any exception. All orders of clergy, therefore, took precedence of him. For religious offices the abbot and his monks were commanded to attend the nearest church.

Abbots were originally subject to episcopal jurisdiction, and continued generally so in the West till the 11th century. The first case recorded of the partial exemption of an abbot from episcopal control is that of Faustus, abbot of Lerins, at the council of Arles, A.D. 456; but the exorbitant claims and exactions of bishops rendered it increasingly frequent, and, in the 6th century, the practice of making religious houses responsible to the Pope alone received an impulse from Gregory the Great. These exceptions, introduced with a good object, had grown into a widespread evil by the 12th century, the bishop being deprived of all authority over the chief centres of influence in his diocese. Abbots more and more assumed almost episcopal state, and adopted the episcopal insignia of mitre, ring, gloves and sandals, a custom which arose out of the granting by the Pope of the right to wear the mitre to particular distinguished abbots.

The first undoubted instance is the bull by which Alexander II. in 1063 granted the use of the mitre to Egelsinus, abbot of St. Augustine at Canterbury (*see* MITRE).

The adoption of episcopal insignia by abbots was followed by an encroachment on episcopal functions, which was ineffectually guarded against by the Lateran Council, A.D. 1123. In A.D. 1489 they were permitted by Innocent IV. to confer both the subdiaconate and diaconate. They always and everywhere had the power of admitting their own monks and vesting them with the religious habit. Originally the bishop of the diocese chose the abbot out of the monks of the convent, but the right of election was transferred by jurisdiction to the monks themselves, reserving to the bishop the confirmation of the election and the benediction of the new abbot. In abbeys exempt from episcopal jurisdiction the confirmation and benediction had to be conferred by the Pope in person, the house being taxed with the expenses of the new abbot's journey to Rome. An abbot had to be at least 25 years of age, of legitimate birth, and a monk of the house, unless it furnished no suitable candidate. The election was for life, unless the abbot was canonically deprived by the chiefs of his order, or, when he was directly subject to them, by the Pope or the bishop. The power of the abbot was absolute, limited only by the canons of the church and, until the general establishment of exemptions, by episcopal control. As a rule, however, implicit obedience was enforced.

The abbot was treated with the utmost reverence by the brethren of his house. If he gave a command, the monk receiving it was to kneel. No monk might sit in his presence, or leave it without his permission. In the East he was commanded to eat with the other monks. In the West the rule of St. Benedict appointed him a separate table, at which he might entertain guests and strangers. This permission opening the door to luxurious living, the Council of Aix, A.D. 817, decreed that the abbot should dine in the refectory on the same fare as the monks, unless he had to entertain a guest. These ordinances proved, however, generally ineffectual, and contemporaneous literature abounds with satirical remarks and complaints concerning the inordinate extravagance of the tables of the abbots

The ordinary dress of the abbot was according to rule to be the same as that of the monks But by the 10th century the rule was commonly set aside, and we find frequent complaints of abbots adopting sumptuous attire. They sometimes even laid aside the monastic habit altogether With the increase of wealth and power, abbots, in fact, lost much of their religious character, and vied in magnificence with the first nobles of the realm They rode on mules with gilded bridles, rich saddles and housings, carrying hawks on their wrists, followed by an immense train of attendants. They associated on equal terms with laymen of the highest distinction, and shared all their pleasures and pursuits This rank and power was, however, often used most beneficially. For instance, Richard Whiting, the last abbot of Glastonbury, judicially murdered by Henry VIII. in 1539, educated in his household as many as 300 sons of noblemen and gentlemen, besides others of a meaner rank, whom he fitted for the universities The abbots of Cluny and Vendôme were, by virtue of their office, cardinals of the Roman church.

In process of time the title abbot was improperly transferred to clerics who had no connection with the monastic system, as to the principal of a body of parochial clergy. It even came to be adopted by purely secular officials. Thus the chief magistrate of the republic at Genoa was called *Abbas Populi* ("the abbot of the people"). Lay abbots were the outcome of the growth of the feudal system from the 8th century onwards. The practice of *commendation,* by which (to meet a temporary emergency) the revenues of the community were handed over to a lay lord and in return for his protection, early suggested to the emperors and kings the expedient of rewarding their warriors with rich abbeys held *in commendam.* During the Carolingian epoch the custom grew up of granting these as regular heritable fiefs or benefices, and by the 10th century the system was firmly established. The example of the kings was followed by the feudal nobles, sometimes by making a temporary concession permanent, sometimes without any form of commendation whatever.

These lay abbacies were not merely a question of overlordship but implied the concentration in lay hands of all the rights, immunities and jurisdiction of the foundations; *i.e.,* the more or less complete secularization of spiritual institutions. The lay abbot took his recognized rank in the feudal hierarchy, and was free to dispose of his fief as in the case of any other.

In conventual cathedrals, where the bishop occupied the place of the abbot, the functions usually devolving on the superior of the monastery were performed by a prior.

The title *abbé* (French), as commonly used in the Roman Catholic church on the European continent, is the equivalent of the English "Father," being loosely applied to all who have received the tonsure. In the German Evangelical church the title of abbot (*Abt*) is sometimes bestowed, like *abbé,* as an honorary distinction, and sometimes survives to designate the heads of monasteries converted at the Reformation into collegiate foundations. Of these the most noteworthy is the abbey of Lokkum in Hanover, founded as a Cistercian house in 1163 by Count Wilbrand of Hallermund, and reformed in 1593.

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**ABBOTSFORD,** former residence of Sir Walter Scott, on south bank of the Tweed, about 3m. W. of Melrose, Roxburghshire, Scotland, and nearly 1m. from Abbotsford Ferry Station, L.N.E.R branch line. Cartleyhole, nicknamed Clarty (muddy) Hole, a farm of 100ac., was bought by Scott (1811) when his lease of Ashestiel, near by, lapsed; he added to it and finally bought Toftfield (afterwards Huntlyburn) in 1817, building his house in Scottish baronial style with relics from historical structures such as the doorway of the old Tolbooth in Edinburgh. A reverse of

fortune in 1825 involved Scott in debt, but the creditors made him a free gift of the library in 1830 and Robert Cadell the publisher cancelled all mortgages in 1847 in exchange for the family's share in the copyright of Sir Walter's works. The house remained in the hands of the Maxwell-Scotts, descendants of Scott. Abbotsford gave its name to the Abbotsford club, a successor of the Bannatyne and Maitland clubs, founded by W. B. D. D. Turnbull in 1834 in Scott's honour, for printing and publishing historical works connected with his writings. Its publications extended from 1835 to 1864.

**ABBOTT, EDWIN ABBOTT** (1838–1926), English schoolmaster and grammarian, succeeded G. F. Mortimer as headmaster of the City of London School in 1865. He was the author of a *Shakespearian Grammar* (1870), which is a permanent contribution to English philology, and of many theological works, among them the article on the Gospels in the 9th ed. of the *Encyclopædia Britannica.*

His brother, Evelyn Abbott (1843–1901), was a tutor of Balliol, Oxford, and author of a scholarly *History of Greece.*

**ABBOTT, EMMA** (1849–1891), American singer, was born in Chicago, Ill., and studied in Milan and Paris. She had a fine soprano voice, and appeared first in opera in London at Covent Garden, also singing at important concerts. She organized an opera company known by her name, and toured extensively in the United States, where she had a great reputation. In 1873 she married E. J. Wetherell. She died at Salt Lake City (Utah), Jan. 5, 1891.

**ABBOTT, GEORGE** (1889– ), American playwright, was born in Forestville, N.Y., on June 25, 1889. He graduated at the University of Rochester (1911), where he wrote and acted for the dramatic club. The following year he studied dramatic writing with Prof. George Pierce Baker at Harvard, had a one-act play produced by the Harvard dramatic club, and won a prize play contest at the Keith Bijou theatre. In order to learn more about the stage and before having any plays accepted for professional productions he became an actor. He appeared in important rôles in *Zander the Great,* with Alice Brady; *Hell Bent for Heaven* and *Processional,* where his acting of the blinded Ishmaelite was particularly outstanding, and other Broadway productions. His first play to be produced, *Fall Guy* (published in the *Best Plays of 1924–25*), was written in collaboration with James Gleason; the next, *Love 'Em and Leave 'Em,* with John V. A. Weaver; *The Holy Terror,* with Winchell Smith; and *Four Walls,* with Dana Burnet. His *Broadway,* written with Phillip Dunning, was one of the dramatic successes of 1926–27 as was *Coquette* (with Ann Preston Bridgers) in 1927–28 and *Three Men on a Horse* (with J. C. Holm) eight years later. He also became well known as a producer of plays and motion pictures.

**ABBOTT, GRACE** (1878–1939), U.S. social reformer, was born in Grand Island, Neb., Nov. 17, 1878. She took her bachelor's degree from Grand Island college in 1898 and her master's degree from The University of Chicago in 1909. In 1908 she went to Hull House, Chicago, as director of the new Immigrants' Protective league. While director of the child-labour division, U.S. children's bureau (1917–19), she administered the first federal child-labour law. She was secretary of the Illinois State Immigrants' commission (1919–21) and chief of the U.S. children's bureau (1921–34), where she administered the Maternity and Infancy act (1922–29). She was U.S. delegate to the International Labour organization in 1935 and 1937 and was professor of public welfare at The University of Chicago from 1934 to 1939. She died June 19, 1939.

She wrote *The Immigrant and the Community* (1917), *Reports of Chief of Children's Bureau* (1922–34), *The Child and the State,* 2 vol. (1938), and *From Relief to Social Security* (1940). (E. Ab.)

**ABBOTT, JACOB** (1803–1879), American writer of books for the young, was born at Hallowell (Me.) on Nov. 14, 1803. He graduated at Bowdoin college in 1820; studied at Andover Theological Seminary. He was tutor in 1824–25, and from 1825 to 1829 was professor of mathematics and natural philosophy in Amherst college; was licensed to preach by the Hampshire Association in 1828; founded the Mt. Vernon School for young ladies in Boston in 1829, and was principal until 1833; was pastor of Eliot Congregational church (which he founded) at Roxbury (Mass.), in 1834–35; and was, with his brothers, a founder, and in 1843–51 a principal, of Abbott's Institute, and in 1845–48 of the Mt. Vernon School for boys, in New York city. He was a prolific author, writing juvenile stories, brief histories and biographies, and religious books for the general reader, and a few works in popular science. He died on Oct. 31, 1879, at Farmington (Me.), where he had spent part of his time since 1839. The best known of his writings are those which feature the boyish paragon Rollo—*Rollo at Work, Rollo at Play, Rollo in Europe,* etc. (28 vol.). In these didactic tales Abbott did for one or two generations of young American readers a service not unlike that performed earlier by the author of *Sandford and Merton.* Of his other writings the best are the *Franconia Stories* (10 vol.), 22 vol. of biographical histories and the *Young Christian.*

*See* his *Young Christian, Memorial Edition. with a Sketch of the Author by One of His Sons; i e,* Edward Abbott (1882), with a bibliography of his works; also Lyman Abbott, *Silhouettes of My Contemporaries* (1921).

**ABBOTT, SIR JAMES** (1807–1896), British soldier, educated at the Military college, Addiscombe. He served in the Bengal artillery at the siege of Bhurtpore. 1825–26. He was the first Englishman to visit Khiva, where he was sent on a mission in 1839. During the Sikh war of 1848–49, he held Hazara, of which he was commissioner (1847–54). He died Oct. 6, 1896.

*See* J. Abbott, *Narrative of a Journey from Heraut to Khiva,* 2 vol., 3rd ed. (London, 1884).

**ABBOTT, JOHN STEVENS CABOT** (1805–1877), American writer, was born in Brunswick, Me., on Sept. 18, 1805. He was a brother of Jacob Abbott, with whom he was associated in the management of Abbott's Institute, New York city, and in the preparation of his series of brief historical biographies. He is best known, however, as the author of a partisan and unscholarly but very readable *History of Napoleon Bonaparte* (1855). Dr. Abbott graduated at Bowdoin college in 1825, studied at Andover theological seminary, and between 1830 and 1844, when he retired from the ministry, preached successively at Worcester, Roxbury and Nantucket, Massachusetts. He died at Fair Haven, Conn., on June 17, 1877. He was a voluminous writer of books on Christian ethics, and of popular histories.

**ABBOTT, LYMAN** (1835–1922), American divine and author, was born at Roxbury (Mass.), on Dec. 18, 1835, the son of Jacob Abbott. He graduated at New York university in 1853, studied law, and was admitted to the bar in 1856; but abandoning the legal profession, after studying theology with his uncle, J. S. C. Abbott, he was ordained a minister of the Congregational church in 1860. After pastorates in Terre Haute (Ind.), and New York City, he became an associate editor of *Harper's Magazine,* editor of the *Illustrated Christian Weekly,* and co-editor (1876–81) of *The Christian Union* with Henry Ward Beecher, whom he succeeded in 1888 as pastor of Plymouth church, Brooklyn. From this pastorate he resigned 11 years later. From 1881 he was editor-in-chief of *The Christian Union,* renamed *The Outlook* in 1893; this periodical reflected his efforts toward social reform and his humane and liberal theology. To the end of his long life he continued to take an active and authoritative part in the discussion of public questions. He died in New York City on Oct. 22, 1922.

The serenity and dignity of his life are reflected in his works which include, besides his many magazine articles, *Jesus of Nazareth* (1869); *Evolution of Christianity* (Lowell Lectures, 1896); *The Theology of an Evolutionist* (1897); *Christianity and Social Problems* (1897); *Life and Letters of Paul* (1898); *Problems of Life* (1900); *The Rights of Man* (1901); *Henry Ward Beecher* (1903); *The Christian Ministry* (1905); *The Personality of God* (1905); *Industrial Problems* (1905); *America in the Making* (1911); and *Reminiscences* (1915).

**ABBOTT, WILBUR CORTEZ** (1869–1947), U.S. educator and historian, was born in Kokomo, Ind., Dec. 28, 1869. Following his graduation from Wabash college, Crawfordsville, Ind., in 1892, he pursued graduate studies at Cornell university and in Europe. Upon returning from Europe, he taught history at the University of Michigan, Ann Arbor, 1897–99. Abbott was assistant professor of history at Dartmouth college, Hanover,

N.H., 1899–1902; professor of European history at the University of Kansas, Lawrence, 1902–08; and professor of history at Yale university, 1908–20, and at Harvard university, 1920–37. He was a research associate in history at Yale, 1938–46. He died on March 27, 1947. Among his published works are *The Expansion of Europe* (1918); and (ed, with others) *The Writings and Speeches of Oliver Cromwell*, 4 vol. (1937–47).

**ABBOTTABAD**, a town of Pakistan, 4,120 ft above sea level, 63 mi from Rawalpindi, formerly the headquarters of the Hazara district in the North-West Frontier province, called after its founder, Sir James Abbott, who settled this wild district after the annexation of the Punjab. Pop (1941) 27,424. It was an important military cantonment and sanatorium, being the headquarters of a brigade in the Rawalpindi division of the northern Indian army It is remarkable for the rock inscription of Asoka close by

**ABBREVIATION.** Strictly a shortening, an abbreviation more particularly is a letter or group of letters taken from a word or words and employed to represent it or them for the sake of brevity. Abbreviations, both of single words and of phrases, having a meaning more or less fixed and recognized, were common in ancient writings and inscriptions (*see* PALAEOGRAPHY). A common form of abbreviation is the substitution for a word of its initial letter, but one or more of the other letters are frequently added. Letters are often doubled to indicate a plural or a superlative There is no occasion to explain here the common abbreviations for Christian names or for geographical place names (listed separately in vol. 24) or for the chemical elements (listed separately under ATOMIC WEIGHTS) Also omitted are those abbreviations which have passed into common usage as words in their own rights; *e g*, Cominform, gestapo, radar, etc.

No universally accepted rule as to the use of periods in abbreviations has been followed One common method, and the one used in this article, is to use periods after the initials of all organizations except U S. government agencies and some, but not all, organizations whose letters form pronounceable words such as WAVES, etc.

In cases where the abbreviation has multiple meanings, only the most common are given.

## COMMON ABBREVIATIONS

| | |
|---|---|
| a. | alto, adjective; answer; accepted |
| A | angstrom, the international wave-length unit, 1938 |
| Å | Ångström scale of wave lengths, 1868–1938 |
| A1 | first class |
| AA | anti-aircraft |
| AAA | Agricultural Adjustment administration |
| A A A. | American Automobile association |
| A A A L | American Academy of Arts and Letters |
| A A A S. | American Association for the Advancement of Science |
| A A F | army air forces |
| A A G. | assistant adjutant general |
| A A P S | American Association for the Promotion of Science |
| A A S. | fellow of the American academy (of Arts and Sciences) |
| A A.U | Amateur Athletic union |
| A A U P | American Association of University Professors |
| A.A U W. | American Association of University Women |
| A.B. | able-bodied seaman; bachelor of arts |
| abbr., abbrev | abbreviated; abbreviation |
| ABC | American Broadcasting company |
| A B.C. | Argentina, Brazil and Chile |
| *ab init.* | (*ab initio*) from the beginning |
| abl. | ablative |
| Abp. | archbishop |
| abr. | abridged, abridgment |
| abs. | absolute |
| ABSIE | American Broadcasting Station in Europe |
| ac. | acre(s) |
| a/c | account |
| A C. | (*ante Christum*) before Christ; alternating current; army corps; air corps |
| acad. | academy |
| acc. | accusative |
| *accel.* | (*accelerando*) increasing speed |
| A.C.S. | American College of Surgeons; American Chemical society |
| ACTH | adrenocorticotropic hormone |
| ad., advt. | advertisement |
| A D. | (*anno Domini*) in the year of our Lord |
| A.D.A. | Americans for Democratic Action |
| *adag.* | (*adagio*) slow |
| A.D.C. | aide-de-camp |
| *ad fin.* | (*ad finem*) at or to the end |
| *ad inf.* | (*ad infinitum*) to infinity |
| *ad init.* | (*ad initium*) at the beginning |
| *ad int.* | (*ad interim*) in the meantime |
| adj | adjective |
| Adjt Gen. | adjutant general |
| *ad lib* | (*ad libitum*) at one's pleasure |
| *ad loc.* | (*ad locum*) at the place |
| Adm | admiral(ty) |
| adv | adverb |
| *ad val.* | (*ad valorem*) according to value |
| A E. and P. | ambassador extraordinary and plenipotentiary |
| A E C. | Atomic Energy commission (U.S) |
| A E F. | American expeditionary force |
| *aet, aetat.* | (*aetatis*) aged |
| A F. | Anglo-French |
| A F C. | air force cross (Brit.) |
| A F M. | air force medal (Brit); American Federation of Musicians |
| A F. of L. | American Federation of Labor |
| A G.F. | army ground forces |
| agr, agric. | agriculture; agricultural |
| agt. | agent |
| a h | ampere hour(s) |
| A.H. | (*anno Hegirae*) in the year of the hegira (Mohammedan era) |
| A I.A. | American Institute of Architects |
| A I.E E. | American Institute of Electrical Engineers; associate of the Institution of Electrical Engineers (Brit.) |
| A.I.F. | Australian imperial force |
| A.I M. & M.E. | American Institute of Mining and Metallurgical Engineers |
| A L. | American Legion |
| A L A. | American Library association |
| Ald. | alderman |
| A.L of H | American Legion of Honor |
| A.L P. | American Labor party |
| alt. | altitude; alternate |
| AM | amplitude modulation |
| Am, Amer. | American |
| A.M. | (*ante meridiem*) before noon; (*anno mundi*) in the year of the world; master of arts |
| A M A. | American Medical association |
| Amg | Allied military government of occupied territory |
| amp. | ampere(s) |
| amt. | amount(s) |
| Amvets | American Veterans of World War II |
| A N | Anglo-Norman |
| A N.A. | associate of the National Academy of Design |
| anal. | analysis |
| anc. | ancient |
| A.N.C. | army nurse corps |
| *and.* | (*andante*) moderately slow |
| Angl. | Anglican |
| anon. | anonymous |
| ans. | answer |
| ant. | antonym |
| ant, antiq. | antiquities; antiquarian |
| Anzac | Australian and New Zealand army corps |
| A.O H. | Ancient Order of Hibernians |
| A P | Associated Press |
| A P I | American Petroleum institute |
| A P O. | army post office |
| app. | appointed; appendix; apparent |
| approx | approximately |
| A.Q.M G | assistant quartermaster general |
| Ar, Arab. | Arabic; Arabian |
| A R A. | associate of the Royal Academy; American Railway association |
| A R C. | American Red Cross |
| arch | architecture; archaic |
| Archd | archdeacon; archduke |
| A R.C.M. | associate, Royal College of Music (Brit) |
| A.R.C.S. | associate, Royal College of Science (Brit) |
| arg | argent (heraldic) |
| A R I B A. | associate of the Royal Institute of British Architects |
| arith. | arithmetic, arithmetical |
| Arm. | Armoric |
| A R P | air-raid precautions |
| A.R.S.A. | associate of the Royal Scottish academy |
| A.R V | American revised version (Bib.) |
| AS, A.S. | Anglo-Saxon |
| ASCAP | American Society of Composers, Authors and Publishers |
| A.S C.E. | American Society of Civil Engineers |
| A.S.F. | army service forces |
| A.S M.E. | American Society of Mechanical Engineers |
| ass., assn., assoc. | association |
| asst. | assistant |
| ASTP | Army Special Training program |
| astr, astron. | astronomical; astronomy |
| AT | anti-tank |
| ATC | air transport command |
| atm. | atmosphere(s); atmospheric |
| A T.S. | auxiliary territorial service (Brit.) |
| atty. | attorney |
| Atty. Gen. | attorney general |
| at. wt. | atomic weight |
| A.U. | angstrom unit, 1938 |
| Å.U. | Ångström unit, 1868–1938 |
| A.U.C. | (*anno urbis conditae*) from the founding of the city (Rome) |
| av., ave. | avenue; average |
| A.V. | authorized version of the Bible |
| A.V.C. | American Veterans committee |
| avoir. | avoirdupois |

| | |
|---|---|
| A W O L | absent without leave |
| AWVS | American Women's Voluntary services |
| b. | born |
| B.A. | bachelor of arts |
| bal. | balance |
| Bapt. | Baptist |
| B.Arch. | bachelor of architecture |
| bart., bt. | baronet |
| B B.C. | British Broadcasting corporation |
| bbl. | barrel(s) |
| B C. | before Christ |
| BCG | Bacillus-Calmette Guérin |
| B D. | bachelor of divinity |
| bd ft. | board foot; board feet |
| Bé. | Baumé (degrees) |
| B Ed. | bachelor of education |
| B E.F. | British expeditionary force |
| BES | bureau of employment security |
| BEW | Board of Economic Warfare |
| b.f. | boldface |
| b h p. | brake horsepower |
| Bib., bibl. | Bible, biblical |
| bibliog. | bibliography, bibliographer |
| biog. | biography; biographical |
| bk. | bank, book, bark |
| bkt. | basket(s) |
| b l. | bill of lading |
| bldg. | building |
| B L.E. | [illegible] of Locomotive Engineers |
| blk. | black; block |
| BLS | bureau of labour statistics |
| blvd, boul. | boulevard |
| b m. | board measure |
| B M | bachelor of medicine |
| B.M.I. | Broadcast Music, Inc. |
| bn | battalion |
| B.O A.C. | British Overseas Airways corporation |
| b.p | boiling point |
| Bp | bishop |
| B P.O.E. | Benevolent and Protective Order of Elks |
| Brig. | brigade; brigadier |
| Brig. Gen. | brigadier general |
| Brit. | British |
| Bros. | brothers |
| B.S, B.Sc. | bachelor of science or sciences |
| B S A. | Boy Scouts of America |
| B Th. | bachelor of theology |
| B.T.U. | British thermal unit(s) |
| bu | bushel(s) |
| bull. | bulletin |
| B V.M. | the Blessed Virgin Mary |
| bx. | box(es) |
| *c.* | (*circa*) about |
| c., ¢, ct. | cent |
| c., *cap.*, ch., chap. | (*caput*) chapter |
| C. | centigrade |
| C.A. | chartered accountant; coast artillery |
| CAA | Civil Aeronautics administration |
| CAB | Civil Aeronautics board |
| cal. | calorie(s) |
| Cantab. | (*Cantabrigiensis*) of Cambridge (university) |
| Capt. | captain |
| car., k. | carat(s) |
| Card. | cardinal |
| cat. | catalogue |
| Cath. | Catholic; cathedral |
| cav. | cavalry |
| C.B. | Companion (of the Order) of the Bath (Brit.) |
| C.B.E. | Commander, Order of the British Empire |
| CBS | Columbia Broadcasting system |
| c.c. | cubic centimetre(s) |
| CCC | Civilian Conservation corps; Commodity Credit corporation |
| C.D.S., D.S.O. | Companion of the Distinguished Service Order (Brit.) |
| C.E. | civil engineer; Christian Endeavor; Church of England |
| CEA | Commodity Exchange authority |
| C.E D. | Committee for Economic Development |
| C E F. | Canadian expeditionary force |
| Celt. | Celtic |
| cent | (*centum*) a hundred |
| *cet. par.* | (*ceteris paribus*) other things being equal |
| *cf.* | compare |
| C G. | coast guard |
| cg | centigram(s) |
| c g s, C G S. | centimetre-gram-second(s) |
| C G T. | (*Confédération Générale du Travail*) General Confederation of Labour (Fr) |
| C H. | Companion of Honour (Brit.) |
| ch. | church |
| Chap. | chaplain |
| Chem.E. | chemical engineer |
| C.I E. | Companion (of the Order) of the Indian Empire (Brit.) |
| Cie | (*compagnie*) company |
| c i f | cost, insurance, freight |
| C I O. | Congress of Industrial Organizations |
| cl | centilitre(s) |
| clk | clerk |
| C M | common metre(s) |
| cm | centimetre(s) |
| C M G. | Companion (of the Order) of St Michael and St. George (Brit.) |
| cml. | commercial |
| C O | commanding officer |
| Co | company; county |
| c o, c/o | care of |
| C O D. | cash on delivery |
| col | colony; column |
| coll | collector; collection; college |
| colloq. | colloquial; colloquialism; colloquially |
| com. | commerce; commission; committee |
| Comdr., Comm. | commander |
| Comdt | commandant |
| COMINCH | commander in chief of the U.S. fleet |
| Com in Chf | commander in chief |
| comp. | comparative; compare; compound; compounded |
| Com Ver. | common version (Bib.) |
| *con., cont.* | (*contra*) against |
| conf. | conference |
| Cong. | congregation; Congregational; Congregationalist; congress |
| conj | conjunction |
| const. | constitution; constable; constant |
| constr. | construction |
| cont. | contents; continued |
| co-op. | co-operative |
| cop, Copt. | Coptic |
| Corp | corporal; corporation |
| corr. | correspond; correspondent; corresponding; corrected |
| cos | cosine |
| cot, ctn | cotangent |
| C P. | chemically pure; common pleas; court of probate |
| cp | candlepower |
| C.P.A. | Canadian Pacific Air Lines Ltd.; certified public accountant |
| C P.O. | chief petty officer |
| C.R. | (*Custos Rotulorum*) Keeper of the Rolls |
| Cr. | creditor; credit |
| *cres.* | (*crescendo*) with gradually increasing volume |
| CSC | civil service commission |
| csc | cosecant |
| C.S.I. | Companion (of the Order) of the Star of India |
| C.S.O. | chief signal officer; chief staff officer |
| C S.T. | central standard time |
| ctr. | centre |
| cu. | cubic |
| cu cm. | cubic centimetre(s) |
| cu ft | cubic foot; cubic feet |
| cu in | cubic inch(es) |
| C.V.O. | Companion of the (Royal) Victorian Order |
| CWA | Civil Works administration |
| CWAC | Canadian women's army corps |
| cwt. | hundredweight(s) |
| C Y.O. | Catholic Youth organization |
| *d.* | (*denarius*) penny |
| D A. | district attorney |
| D A.R. | Daughters of the American Revolution |
| D A V. | Disabled American Veterans |
| dat. | dative |
| D B.E. | Dame (Commander of the Order) of the British Empire |
| D C. | (*da capo*) from the beginning; direct current |
| dcg. | decagram(s) |
| dcl. | decalitre(s) |
| D.C.L. | doctor of civil law |
| dcm. | decametre(s) |
| D.C.M. | distinguished conduct medal (Brit.); district court martial |
| D D | doctor of divinity |
| D D M., D M D. | doctor of dental medicine |
| D D S | doctor of dental surgery |
| DDT | dichloro-diphenyl-trichloroethane |
| decim. | decimetre(s) |
| *decresc.* | (*decrescendo*) with gradually decreasing volume |
| deg. | degree(s) |
| *del.* | (*delineavit*) he or she drew it |
| dele. | (*deleatur*) delete |
| Dem. | Democrat; Democratic |
| D Eng. | doctor of engineering |
| dep. | deputy |
| dept. | department |
| DF | direction-finding |
| D F.C. | distinguished flying cross (Brit.) |
| dg | decigram(s) |
| D G. | (*Dei gratia*) by the grace of God |
| diam. | diameter |
| dict. | dictator; dictionary |
| diff. | difference |
| *dim.* | (*diminuendo*) with gradually diminishing volume |
| dl. | decilitre(s) |
| DLC | Disaster Loan corporation |
| D Litt. | doctor of letters |
| D.L O. | dead-letter office |
| dm. | decimetre(s) |
| DME | distance measuring equipment |
| D.M.S. | doctor of medical science |
| D.Mus. | doctor of music |
| D N.B. | (*Deutsches Nachrichten Buro*) nazi official news agency |
| do. | (*ditto*) the same |
| dol. | dollar, now expressed by $ |
| dopa | dihydroxyphenylalanine |
| doz. | dozen |
| DP | displaced person |
| dpt. | department |
| Dr. | debtor; doctor |
| dr. | drachm(s) or dram(s) |
| D.S C. | distinguished service cross |
| D Sc | doctor of science |
| D S M. | distinguished service medal |
| D.S O. | (Companion of the) Distinguished Service Order |
| D.S.T. | daylight saving time |
| Du. | Dutch |
| Duo. | duodecimo |
| D.V. | (*Deo volente*) God willing |
| D.V.M. | doctor of veterinary medicine |
| D.V.S. | doctor of veterinary surgery |
| dwt. | pennyweight |
| E | excellence in production (U.S. army and navy award) |
| E. | east |
| ea. | each |
| E. & O.E. | errors and omissions excepted |
| *Ebor.* | (*Eboracensis*) of York |

| | |
|---|---|
| ECA | European Cooperation administration |
| ed. | editor; edition, educated |
| Edin. | Edinburgh |
| E.E. | Early English, electrical engineer; errors excepted |
| E.E & M.P. | envoy extraordinary and minister plenipotentiary |
| *e.g.* | *exempli gratia*: example |
| e m f | electromagnetic force |
| E M F. | electromotive force |
| Emp | empire, emperor |
| ency., encyc. | encyclopedia |
| E N E | east-northeast |
| Eng | English |
| E N W. | east-northwest |
| ERP | European Recovery program (Marshall plan) |
| E S E. | east-southeast |
| esp, espec. | especially |
| Esq | esquire |
| est. | established; estimated |
| E S T | eastern standard time |
| E S U, UES | electrostatic unit(s) |
| E S W. | east-southwest |
| *et al.* | (*et alii* or *aliae*) and others; (*et alibi*) and elsewhere |
| etc | (*et cetera*) and so forth |
| E T O. | European theatre of operations |
| *et seq.* | (*et sequens, sequentes* or *sequentia*) and the following |
| ev | electron volt(s) |
| ex. | example |
| exp. | export |
| f. | farad(s) |
| f., fem. | feminine |
| *f.* | (*forte*) loud, powerful |
| F. | Fahrenheit |
| F A | field artillery |
| F. and A M. | Free and Accepted Masons |
| facsim. | facsimile |
| F A O. | Food and Agriculture organization |
| F.B.A. | fellow of the British academy |
| FBI | Federal Bureau of Investigation |
| FCA | Farm Credit administration |
| FCC | Federal Communications commission |
| FCIC | Federal Corp Insurance corporation |
| F C S. | fellow of the Chemical society |
| F.D. | (*fidei defensor*) Defender of the Faith (Brit.); fire department |
| FDA | Federal Drug administration |
| FDIC | Federal Deposit Insurance corporation |
| FEA | Foreign Economic administration |
| *fec.* | (*fecit*) he (or she) made (or did) (it) |
| F E C. | Far Eastern commission |
| fed. | federal |
| F E P.C. | Fair Employment Practices committee |
| FERA | Federal Emergency Relief administration |
| *ff.* | (*fortissimo*) very loud; following (pages) |
| F.F I. | French Forces of the Interior |
| F.G.S. | fellow of the Geological society |
| FHA | Federal Housing administration |
| F.I.C. | fellow of the Institute of Chemistry (of Great Britain and Ireland) |
| fig. | figuratively; figure(s) |
| Finn. | Finnish |
| fl. | flourished |
| fl oz. | fluid ounce(s) |
| F.L.S. | fellow of the Linnaean society |
| FM | frequency modulation |
| F.M. | field marshal |
| fm. | fathom(s) |
| F.O. | foreign office |
| fo., fol. | folio |
| f o.b. | free on board |
| FPC | Federal Power commission |
| FPHA | Federal Public Housing authority |
| f p s. | foot-pound-second; feet per second |
| F.P S. | fellow of the Philological society (Brit.) |
| Fr | French |
| fr. | franc(s); from; father |
| F R A I. | fellow of the Royal Anthropological institute (of Great Britain and Ireland) |
| F R A S. | fellow of the Royal Astronomical society (Brit.) |
| F R C P. | fellow of the Royal College of Physicians, London |
| F R C P E | fellow of the Royal College of Physicians of Edinburgh |
| F R C S. | fellow of the Royal College of Surgeons, London |
| F.R C V S. | fellow of the Royal College of Veterinary Surgeons (Brit.) |
| FREB | Federal Real Estate board |
| F R G S. | fellow of the Royal Geographical society, London |
| F.R Hist.S | fellow of the Royal Historical society, London |
| F R.H.S | fellow of the Royal Horticultural society, London |
| F R I B.A. | fellow of the Royal Institute of British Architects |
| F R S | fellow of the Royal society (of London) |
| F R S E. | fellow of the Royal Society of Edinburgh |
| F.R S.L. | fellow of the Royal Society of Literature (of the United Kingdom) |
| FSA | Farm Security administration; Federal Security agency |
| F S.A. | fellow of the Society of Antiquaries (of London) |
| FSLIC | Federal Savings and Loan Insurance corporation |
| F S.S. | fellow of the Statistical society (of London) |
| ft | foot; feet |
| FTC | Federal Trade commission |
| ft lb. | foot pound(s) |
| fur. | furlong(s) |
| *f.v.* | (*folio verso*) on the back of the page |
| FWA | Federal Works agency |
| F Z S. | fellow of the Zoological society, London |
| g | gram(s) |
| gal. | gallon(s) |
| GAO | general accounting office |
| G.A R. | Grand Army of the Republic |
| gaz. | gazette, gazetteer |
| G.B.E. | (Knight, Dame) Grand (Cross, Order) of the British Empire |
| GCA | ground controlled approach |
| g cal. | gram calorie(s) |
| G.C.B. | (Knight) Grand Cross (of the Order) of the Bath |
| G.C I E. | (Knight) Grand Commander (of the Order) of the Indian Empire |
| G C.M.G. | (Knight) of the Grand Cross (of the Order) of St. Michael and St. George |
| G.C.S.I. | (Knight) Grand Commander (of the Order) of the Star of India |
| G.C.V.O. | (Knight) Grand Cross of the (Royal) Victorian Order |
| gen. | genitive; general |
| Gen. | general (title) |
| Ger. | German |
| G.H.Q. | general headquarters |
| gi. | gill(s) |
| G.I. | government issue, a U.S. soldier |
| G.M.T. | Greenwich mean time |
| G.O C. | general officer commanding |
| G.O.P. | Grand Old Party (Republican) |
| Goth. | Gothic |
| Gov. | governor |
| govt. | government |
| GPO | government printing office |
| G P.O. | general post office |
| Gr | Greek |
| gr. | grain(s) |
| ha | hectare(s) |
| hdkf | handkerchief |
| hdqrs | headquarters |
| Heb, Hebr | Hebrew(s) |
| her. | heraldic, heraldry |
| hg | hectogram(s) |
| H.H. | His or Her Highness; His Holiness (the pope) |
| hhd | hogshead(s) |
| HHFA | Housing and Home Finance agency |
| H I H | His or Her Imperial Highness |
| H I M. | His or Her Imperial Majesty |
| H J S. | (*hic jacet sepultus*) here lies buried |
| hl. | hectolitre(s) |
| HLBB | Home Loan Bank board |
| hm. | hectometre(s) |
| H M | His or Her Majesty |
| H M S. | His or Her Majesty's ship, or service |
| H.M S O. | His or Her Majesty's stationery office |
| HOLC | Home Owners' Loan corporation |
| Hon | honourable, honorary |
| hosp | hospital |
| h p. | horsepower |
| H Q | headquarters |
| H R | house of representatives; house of representatives bill |
| hr | hour(s) |
| H R H. | His or Her Royal Highness |
| H S H. | His or Her Serene Highness |
| ht | height |
| *ib, ibid.* | (*ibidem*) in the same place |
| I C.A O. | International Civil Aviation organization |
| ICC | Interstate Commerce Com. |
| Icel. | Icelandic |
| I.C. 4-A | Intercollegiate Association of Amateur Athletics in America |
| *id.* | (*idem*) the same |
| *i e.* | (*id est*) that is |
| I.E.F C. | International Emergency Food committee |
| I G. | inspector general |
| i h p. | indicated horsepower |
| IHS | a symbol representing the Greek name of Jesus |
| I L G.W.U. | International Ladies' Garment Workers' union |
| ill., illus. | illustration; illustrated |
| I L O. | International Labour organization |
| ILS | instrument landing system |
| imp. | imperative; imperfect (tense); imperial; (*imprimatur*) let it be printed |
| in. | inch(es) |
| Inc. | incorporated |
| incl. | inclosure; inclusive |
| incog. | (*incognito*) unknown |
| ind. | index |
| Ind. | Indian |
| indiv. | individual |
| inf | infantry; infinitive |
| *inf.* | (*infra*) below |
| init. | initial |
| I N.R I. | (*Iesus Nazarenus Rex Iudaeorum*) Jesus of Nazareth, King of the Jews |
| I N.S. | International News service |
| ins. | insurance |
| insp. | inspector |
| Inst. | institute; institution |
| inst. | instant, the present month |
| instr. | instrument |
| insur. | insurance |
| int. | interest |
| internat. | international |
| introd. | introduction; introductory |
| inv. | invoice |
| invt. | inventory |
| I.O.F. | Independent Order of Foresters |
| I.O.G.T. | Independent Order of Good Templars |

| | |
|---|---|
| I.O.O.F. | Independent Order of Odd Fellows |
| I.O.U. | I owe you |
| I.Q. | intelligence quotient |
| *i.q.* | (*idem quod*) the same as |
| Ir. | Irish |
| I.R.O. | International Refugee organization |
| Is. | islands |
| I.S.O. | (Companion of the) Imperial Service Order |
| It., Ital. | Italian |
| it., ital. | italics |
| I.T.O. | International Trade organization |
| I.T.U. | International Telecommunications union |
| I.W.W. | Industrial Workers of the World |
| J., Jour. | journal |
| J.A.G. | judge advocate general |
| Jav. | Javanese |
| J.C.D. | doctor of civil law |
| J.D. | doctor of laws |
| j.g. | junior grade |
| jour. | journal; journey |
| J.P. | justice of the peace |
| Jr. | junior |
| k. | carat(s) |
| K. | Kelvin |
| K.B.E. | Knight (Commander of the Order) of the British Empire |
| K.C. | king's counsel; Knights of Columbus |
| kc. | kilocycle(s) |
| K.C.B. | Knight Commander (of the Order) of the Bath |
| K.C.I.E. | Knight Commander (of the Order) of the Indian Empire |
| K.C.M.G. | Knight Commander (of the Order) of St. Michael and St. George |
| K.C.S.I. | Knight Commander (of the Order) of the Star of India |
| K.C.V.O. | Knight Commander of the (Royal) Victorian Order |
| K.G. | Knight (of the Order) of the Garter |
| kg. | kilogram(s) |
| kg.cal. | kilogram calorie(s); kilocalorie(s) |
| K.K.K. | Ku Klux Klan |
| kl. | kilolitre(s) |
| K.L.M. | Koninklijke Luchtvaart Maatschappy voor Nederland en Kolonien N.V. (Dutch airline) |
| km. | kilometre(s) |
| K.P. | Knight of Pythias; Knight (of the Order) of St. Patrick (Brit.); kitchen police |
| kr. | kroner; króna; krónur |
| Kt. | knight |
| K.T. | Knight(s) Templar; Knight (of the Order) of the Thistle (Scot.) |
| kv. | kilovolt(s) |
| kva. | kilovolt ampere(s) |
| kw. | kilowatt(s) |
| kw.hr. | kilowatt hour(s) |
| l. | litre(s) |
| l., ll. | line(s) |
| L., £ | (*libra*) pound(s) (money) |
| L., lib. | (*liber*) book |
| lat. | latitude |
| Lat. | Latin |
| lb. | (*libra*) pound(s) (weight) |
| l.c. | lower case; letter of credit |
| *l.c., loc. cit.* | (*loco citato*) in the place cited |
| L.C. | landing craft; Library of Congress; lord chamberlain; lord chancellor |
| L.C.C. | London County council |
| L.C.J. | lord chief justice |
| L.G. | Low German |
| L.H.D. | doctor of humanities |
| *lib.* | (*liber*) book; library; librarian |
| Lieut., Lt. | lieutenant |
| Lieut. Col. | lieutenant colonel |
| Lieut. Com. | lieutenant commander |
| Lieut. Gen. | lieutenant general |
| lin. | linear |
| Linn. | Linnaeus; Linnaean |
| liq. | liquid |
| lit. | literally; literature; literary |
| Lith. | Lithuanian |
| lith. | lithograph; lithography |
| Litt D. | doctor of letters |
| L.J. | lord justice |
| L.L., L. Lat. | Low Latin; Law Latin |
| LL.B. | bachelor of laws |
| LL.D. | doctor of laws |
| *loc. cit.* | (*loco citato*) in the place cited |
| log | logarithm |
| long. | longitude |
| *loq.* | (*loquitur*) he (or she) speaks |
| LP | long-playing (phonograph records) |
| L.P.S. | lord privy seal (Brit.) |
| L.R.A.M. | Licentiate of the Royal Academy of Music (Brit.) |
| L.R.C.P. | Licentiate of the Royal College of Physicians (Brit.) |
| L.R.C.P.E. | Licentiate of the Royal College of Physicians, Edinburgh |
| L.R.C.S. | Licentiate of the Royal College of Surgeons (Brit.) |
| L.S. | (*locus sigilli*) place of the seal |
| L.S.A. | Licentiate of the Society of Apothecaries |
| l.s.d. | (*librae, solidi, denarii*) pounds, shillings, pence |
| L.S.D. | landing ship dock |
| L.S.M. | landing ship medium |
| L.S.T. | landing ship tank |
| l.t. | long ton(s) |
| Ltd. | limited |
| Luth. | Lutheran |
| m. | married; metre(s); minim; masculine; milli- |
| M. | (*meridies*) meridian, noon; mark(s); (*mille*) thousand(s); monsieur |
| M.A. | master of arts |
| Maj. | major |
| Maj. Gen. | major general |
| Marq. | marquis |
| masc. | masculine |
| max. | maximum |
| M.B.E. | Member (of the Order) of the British Empire |
| mc. | megacycle(s) |
| M.C. | master of ceremonies; member of congress; military cross; medical corps; marine corps |
| M.D. | doctor of medicine |
| mdse. | merchandise |
| M.E. | Middle English; mechanical engineer; mining engineer |
| mech. | mechanics; mechanical |
| med. | medicine; medical; mediaeval |
| *mem.* | (*memento*) memorandum |
| m.e.p. | mean effective pressure |
| Messrs., MM. | messieurs |
| Met. | metropolitan |
| Meth. | Methodist |
| Mev | million electron volt(s) |
| *m.f.* | (*mezzo forte*) moderately loud |
| mfd., mfg. | manufactured; manufacturing |
| mfrs. | manufacturers |
| mg. | milligram(s) |
| Mgr. | monsignor; manager |
| m.g.s. | metre-gram-second(s) |
| M.H.G. | Middle High German |
| mi. | mile(s) |
| M.I.E.E. | member of the Institution of Electrical Engineers (Brit.) |
| mil., milit. | military |
| M.I.M.E. | member of the Institution of Mining Engineers (Brit.) |
| M.I.Mech. E. | member of the Institution of Mechanical Engineers (Brit.) |
| min. | minute(s); minimum |
| Min.Plen. | minister plenipotentiary |
| misc. | miscellaneous |
| ml. | millilitre(s) |
| M.L. | Mediaeval, or Middle, Latin |
| MLB | Maritime Labor board |
| M.Litt. | master of letters |
| Mlle. | mademoiselle |
| mm. | millimetre(s) |
| mμ | millimicron(s) |
| Mme(s). | madame; mesdames |
| m.m.f. | magnetomotive force |
| M.O. | medical officer; money order |
| mo. | month |
| mod. | modern; (*moderato*) moderately fast |
| M.O.I. | ministry of information (Brit.) |
| mol. | molecule(s) |
| mol wt. | molecular weight |
| m.p | melting point |
| M.P. | member of parliament; military police |
| m.p.h. | miles per hour |
| Mr | mister |
| M.R. | Master of the Rolls (Brit.) |
| M.R.A.S. | member of the Royal Asiatic society (of Great Britain and Ireland); member of the Royal Academy of Science (Brit.) |
| M.R.C.P. | member of the Royal College of Physicians (London) |
| M.R.C.S. | member of the Royal College of Surgeons (Brit.) |
| M.R.C.V.S. | member of the Royal College of Veterinary Surgeons (Brit.) |
| M.R.P. | (*Mouvement Républicain Populaire*) Republican Popular movement (Fr.) |
| Mrs. | mistress |
| ms., mss. | manuscript; manuscripts |
| M.S., M.Sc. | master of science |
| Msgr. | monsignor |
| M.S.T. | mountain standard time |
| Mt., mts. | mount, mountains |
| μ | micron(s); micro- |
| μv | microvolt(s) |
| mus. | museum; music; musical |
| mv | millivolt(s) |
| M.V.O. | member of the (Royal) Victorian Order |
| myth. | mythology; mythological |
| n. | noun |
| n., nn. | note(s) |
| N. | north |
| N.A. | National Academician |
| N.A.A.C.P. | National Association for the Advancement of Colored People |
| N.A.B. | National Association of Broadcasters |
| N.A.C. | National Arts club |
| NACA | National Advisory Committee for Aeronautics |
| N.A.M. | National Association of Manufacturers |
| N.A.N.A. | North American Newspaper alliance |
| N.A.S. | National Academy of Sciences |
| nat. | national; natural |
| naut. | nautical |
| nav. | naval; navigation |
| *n.b.* | (*nota bene*) note well, take notice |
| NBC | National Broadcasting company |
| N.C.A.A. | National Collegiate Athletic association |
| N.C.O., noncom. | noncommissioned officer |
| N.C.W.C. | National Catholic Welfare conference |
| N.C.Y.C. | National Catholic Youth council |
| N.E. | northeast |
| N.E.A. | Newspaper Enterprise association; National Education association |
| N.E.D. | *New English Dictionary* |
| N.E.L.A. | National Electric Light Assoc. |
| *nem.con.* | (*nemine contradicente*) no one contradicting; unanimous |
| N.E.P. | New Economic policy (U.S.S.R) |
| neut. | neuter |
| New Test., N.T. | New Testament |

| | |
|---|---|
| N F.S. | National Fire service (Brit.) |
| N Gr. | New Greek |
| N H.I. | National Health insurance (Brit ) |
| NIRA | National Industrial Recovery act or administration |
| NKVD | (*Narodnyi Komissariat Vnutrennykh Del*) Peoples Commissariat of Internal Affairs, including soviet secret state police |
| N L | New Latin |
| NLRB | National Labor Relations board |
| NMB | National Mediation board |
| N M U. | National Maritime union |
| N N E | north-northeast |
| N N W. | north-northwest |
| no. | (*numero*) number |
| nom | nominative, nominated |
| *non seq.* | (*non sequitur*) it does not follow |
| Nor, Norm. | Norman |
| N P | notary public |
| n p t. | normal (blood) pressure and temperature |
| NRA | National (Industrial) Recovery administration |
| NRPB | National Resources Planning board |
| N S | New Style (calendar) |
| N.W | northwest |
| NWLB | National War Labor board |
| NYA | National Youth administration |
| ob | (*obiit*) he (or she) died |
| O B E. | Order of the British Empire |
| obj. | objective, objection |
| obs. | observation, observatory; obsolete |
| OC | Office of Censorship |
| O C. | officer commanding |
| O C S. | Officer Candidate school |
| O D. | officer of the day; olive drab; overdraft |
| O.E. | Old English |
| O E.E.C. | Organization for European Economic Cooperation |
| OEM | Office for Emergency Management |
| OES | Office of Economic Stabilization |
| OEW | Office of Economic Warfare |
| O F. | Old French |
| OFF | Office of Facts and Figures |
| off. | official |
| O. Gael. | Old Gaelic |
| OGR | Office of Government Reports |
| O.H.G. | Old High German |
| O.H.M.S. | on His or Her Majesty's service |
| O M. | Order of Merit (Brit.) |
| O.N. | Old Norse |
| op. | opus; opera |
| OPA | Office of Price Administration |
| *op cit.* | (*opere citato*) in the work cited |
| OPM | Office of Production Management |
| opp. | opposite; opposed |
| O.R.C. | Officers' Reserve corps |
| orch. | orchestra |
| org. | organic; organized |
| orig. | original; origin; originally |
| O.S. | Old Style (calendar); Old Saxon |
| O.S.A. | Order of St. Augustine |
| O.S.B. | Order of St. Benedict |
| O S F. | Order of St. Francis |
| OSRD | Office of Scientific Research and Development |
| OSS | Office of Strategic Services |
| O.T. | Old Testament |
| O.T.C. | Officers' Training camp or corps |
| O.T.S. | Officers' Training school |
| OWI | Office of War Information |
| Oxon. | (*Oxonia, Oxoniensis*) Oxford; of Oxford |
| oz. | ounce(s) |
| p., pp. | page; pages |
| *p.* | (*piano*) soft |
| P.A.C. | Political Action committee (C.I.O.) |
| par. | paragraph |
| parl. | parliament; parliamentary |
| P.A.S.I. | Professional Associate of the (Chartered) Surveyors' institution (Brit.) |
| pat. | patent |
| patd | patented |
| Pat. Off. | patent office |
| payt. | payment |
| pc. | piece |
| PC | patrol craft (boat) |
| P.C. | privy councillor, police constable |
| P D. | police department |
| pd | paid |
| P E | Protestant Episcopal |
| per, pers | person; |
| pert | pertaining |
| PETN | pentaerythritoltetranitrate |
| *p f* | (*più forte*) a little louder |
| P F C. | private first class |
| pfd | preferred |
| phar. | pharmacy, pharmacopoeia |
| Ph B. | |
| Ph C. | |
| Ph D. | doctor of philosophy |
| phr | phrase |
| phys | physics |
| *pinx., pxt.* | (*pinxit*) he or she painted it |
| *pizz.* | (*pizzicato*) plucked |
| pk. | peck(s) |
| pkg. | package(s) |
| pl. | plural, place, plate |
| P M. | past master, postmaster, (*post meridiem*) afternoon, provost marshal |
| P O. | post office, postal order |
| P O D. | post office department |
| P.O E. | port of embarkation |
| pop | population |
| p o w. | prisoner of war |
| P.P. | parish priest |
| *pp.* | (*pianissimo*) very soft |
| *p.p.c.* | (*pour prendre congé*) to take leave |
| P.P.S. | (*post postscriptum*) an additional postscript |
| P.R. | (*populus Romanus*) the Roman people |
| pr. | pair, price; pronoun |
| PRA | Public Roads administration |
| prep. | preposition |
| pres. | president; present |
| Presb. | Presbyterian |
| press. | pressure(s) |
| prin. | principal |
| proc. | proceedings |
| Prof. | professor |
| pron. | pronoun, pronunciation |
| prop., propr. | proprietor |
| prov. | provisional; provost; province |
| *prox.* | (*proximo* [mense]) next month |
| Prus. | Prussian |
| P.S. | (*postscriptum*) postscript |
| pseud. | pseudonym |
| P S.T. | Pacific standard time |
| pt. | part; pint(s); point; port |
| p.t. or pro tem. | (*pro tempore*) for the time being |
| PT | motor torpedo (boat) |
| P.T.A. | National Congress of Parents and Teachers |
| PTM | pulse time modulation |
| P.T.O. | please turn over |
| pub. | publication; published; public |
| pvt. | private |
| PWA | Public Works administration |
| pwt. | pennyweight |
| q., ql. | quintal |
| Q., Qu. or Qy. | query; question |
| Q.E.D. | (*quod erat demonstrandum*) which was to be demonstrated |
| Q.E.F. | (*quod erat faciendum*) which was to be done |
| *q.l.* | (*quantum libet*) as much as you please |
| Q.M. | quartermaster |
| Q.M.C. | quartermaster corps |
| Q M G. | quartermaster general |
| qr. | quarter; quarterly; quire |
| *q s.* or *quant. suff.* | (*quantum sufficit*) as much as is sufficient |
| qt. | quart(s) |
| Q T. | (on the) quiet |
| *q.v.* | (*quod vide*) which see; (*quantum vis*) as much as you will |
| R. | (*rex, regina*) king, queen; (*recipe*) take |
| R.A. | rear admiral; Royal academy (of Arts, London), royal art; royal artillery |
| rabb. | rabbinical |
| rad. | (*radix*) root |
| R A F. | royal air force |
| *ral.* | (*rallentando*) gradually slower |
| R A M | Royal Academy of Music (Brit ) |
| R A M C. | royal army medical corps (Brit ) |
| R & I. | (*rex et imperator*) king and emperor |
| R A S C. | royal army service corps (Brit ) |
| R B.A. | Royal (Society of) British Artists |
| R C. | Roman Catholic; Red Cross |
| RCA | Radio Corporation of America |
| R C A F. | Royal Canadian air force |
| R E. | royal engineers (Brit ) |
| Ré. | Réaumur's thermometrical scale |
| REA | Rural Electrification administration |
| recd. | received |
| reg, regt | regiment |
| Reg. Prof. | regius professor |
| rel. | religion; relative |
| Rep. | Republican; report; representative |
| ret. | retired |
| rev. | revolution; revenue |
| Rev. | reverend |
| RFC | Reconstruction Finance corporation |
| R F.D. | rural free delivery |
| Rh | Rhesus factor |
| R.I.B.A. | Royal Institution of British Architects |
| R.I.P. | (*requiescat in pace*) may he or she rest in peace |
| *rit.* | (*ritardando*) gradually slower |
| riv. | river |
| R.M. | royal marines; resident magistrate |
| R.M.A. | Royal Military academy (Woolwich) |
| R.M C. | Royal Military college (Sandhurst) |
| R.N. | royal navy; registered nurse |
| R N.V.R. | royal navy volunteer reserve |
| ro. | rood |
| Rom. | Roman; romance |
| R.O.T.C. | Reserve Officers' Training corps |
| r.p.m. | revolutions per minute |
| r.p.s. | revolutions per second |
| R R. | railroad |
| RRB | Railroad Retirement board |
| R.S.V.P. | (*répondez s'il vous plait*) please reply |
| Rt. Hon. | right honourable |
| Rt. Rev. | right reverend |
| R.V. | revised version (Bib.) |
| Ry. | railway |
| *s.* | (*solidus*) shilling |
| S. | San; south |
| S. | senate bill |
| S.A.E. | Society of Automotive Engineers |
| Sans., Sansk. | Sanscrit; Sanskrit |
| S.A.R. | Sons of the American Revolution |
| Sax. | Saxon |
| SBA | standard beam approach |
| *sc., ss.* | (*scilicet*) namely |
| S.C. | signal corps |
| sc. or scr. | scruple |
| s.c. | small capital letters |
| S.C.A.P. | supreme commander for the Allied Powers |
| Sc.D. | doctor of science |

| | |
|---|---|
| sci. | science |
| *sculp., sc., sculpt.* | (*sculpsit*) he or she carved or engraved it |
| *s.d.* | (*sine die*) without (appointing) a day (on which to assemble again) |
| S.E. | southeast |
| sec | secant |
| sec. | section; second(s) |
| SEC | Securities and Exchange Com. |
| Secy. | secretary |
| sen. | senate; senator |
| *seq., sq., seqq.* | (*sequens, sequentia*) the following |
| ser. | series |
| *sf.* | (*sforzando*) with emphasis |
| sgt, sergt | sergeant |
| S H.A.E.F. | supreme headquarters Allied Expeditionary force |
| *sic* | literally; so |
| sin | sine |
| sing. | singular |
| 666 | hexachlorobenzene, insecticide for intestinal parasites |
| S J. | Society of Jesus |
| Slav. | Slavonic |
| SMA | Surplus Marketing administration |
| Soc | society |
| sop. | soprano |
| S O S | wireless distress signal at sea |
| *sost.* | (*sostenuto*) sustained |
| S P. | shore patrol |
| sp | spelling |
| SPAB | Supply, Priorities and Allocations board |
| SPAR | women's reserve of the United States coast guard (contraction of coast guard motto, *semper paratus* [always prepared]) |
| S P.C A | Society for the Prevention of Cruelty to Animals |
| S P C C. | Society for the Prevention of Cruelty to Children |
| spec. | special; specification |
| specif. | specifically |
| S P G. | Society for the Propagation of the Gospel (Brit ) |
| sp gr. | specific gravity |
| sq. | square; squadron |
| sq ft. | square foot; square feet |
| Sr. | senior; señor |
| Sra | señora |
| S R.O. | standing room only |
| Srta. | señorita |
| SS., s s. | saints; steamship |
| SSB | Social Security board |
| S S.E. | south-southeast |
| S S.W. | south-southwest |
| st. | stanza |
| St. | Saint; strait; stone; street |
| Sta. | santa; station |
| *stac.* | (*staccato*) distinct; separated |
| Ste. | sainte |
| S.T P. | professor of sacred theology |
| str. | strait(s) |
| subj. | subject; subjunctive |
| *sup.* | (*supra*) above |
| supp., suppl. | supplement |
| supt | superintendent |
| surg. | surgeon; surgery |
| *s.v.* | (*sub voce*) under the word (or heading) |
| S.W.O.C. | Steel Workers Organizing Com. |
| sym. | symbol |
| syn. | synonym; synonymous |
| t., tsp. | teaspoon(s) |
| T. | ton(s) |
| tan | tangent |
| tart. | tartaric |
| TASS | (*Telegraphnoye Agenstvo Sovyetskovo Soyuza*) soviet news agency |
| t.b. | tubercle bacillus, tuberculosis |
| Tbs., Tbsp. | tablespoon(s) |
| T C.A. | Trans-Canada Air Lines |
| T E. | topographical engineer |
| terr. | territory |
| Teut. | Teutonic; teuton |
| t.i d. | (*ter in die*) three times daily (*abbrev.*) |
| T N T. | trinitrotoluene |
| tp. | township |
| tr. | translated; translator; transpose; treasurer; trustee |
| trans. | transferred; transaction; translation |
| treas. | treasurer; treasury |
| *trem.* | (*tremolo*) trembling; fluttering |
| trig. | trigonometry |
| T.U C. | Trades Union congress or council (Brit.) |
| TV | television |
| TVA | Tennessee Valley authority |
| 2,4-D | a weed killer |
| twp | township |
| T W U. | Transport Workers' union (Brit ) |
| typ. | typographer |
| U., Univ. | university |
| U.A W. | United Automobile Workers |
| u c. | upper case |
| U D C. | United Daughters of the Confederacy |
| UES, U S U | electrostatic unit(s) |
| *ult.* | (*ultimo*) last (month) |
| UMT | universal military training |
| U M.W. | United Mine Workers |
| U.N | United Nations |
| U.N E.S.-C.O. | United Nations Educational, Scientific and Cultural organization |
| Unit | Unitarian |
| U N.R.R.A. | United Nations Relief and Rehabilitation administration |
| U.P. | United Press |
| *u.s.* | (*ubi supra*) in the place above mentioned |
| U.S A. | United States army |
| U S C.G. | United States coast guard |
| USES | United States employment service |
| USFET | U.S. forces in the European theatre |
| USHA | United States Housing authority or administration |
| USIS | U S. Information service |
| U.S.M. | United States mail |
| U S.M.A. | United States Military academy |
| U S.M.C. | United States marine corps |
| U.S.N. | United States navy |
| U S.N.A. | United States Naval academy |
| U S N.R. | United States naval reserve |
| U.S.O. | United Service organizations (for National Defense) |
| U.S.P. | United States Pharmacopoeia |
| USPHS | U S public health service |
| U.S.S. | United States ship; United States senate |
| U S S.S. | United States secret service |
| U.S.W.A. | United Steel Workers of America |
| *v.* | (*versus*) against |
| v. | volt(s) |
| *v.* or *vid.* | (*vide*) see |
| v., vs. | verse |
| V | victory (World War II; as in V-mail, V-for-Victory, etc ) |
| V. | verb; violin |
| VA | Veterans' administration |
| V.A. | vicar apostolic; vice-admiral |
| val. | valley |
| Vat. | vatican |
| V C. | vice-chancellor; Victoria cross |
| V.D. | venereal disease |
| V-E | victory in Europe (World War II) |
| vers. | versed sine |
| vet. | veterinary; veteran |
| V F.W. | Veterans of Foreign Wars |
| V G. | vicar general |
| VHF | very high frequency |
| vil. | village, vilayet |
| Vis., Visc., Visct. | viscount |
| viz. | (*videlicet*) namely |
| V-J | victory in Japan (World War II) |
| *v.l.* | (*varia lectio*) variant reading(s) |
| vocab. | vocabulary |
| V-1 | (*Vergeltungswaffe, eins*· vengeance weapon one) German buzz-bomb |
| vol. | volume(s); volunteers, volcano |
| vox pop. | (*vox populi*) voice of the people |
| V P. | vice-president |
| *v.s.* | (*vide supra*) see above |
| V S. | veterinary surgeon |
| W. | west |
| w. | watt(s) |
| WAC | women's army corps |
| W A A F. | women's auxiliary air force (services) (Brit.) |
| WAFS | women's auxiliary ferrying squadron |
| WASP | women's air force service pilot |
| watt hr. | watt hour(s) |
| WAVES | women appointed for volunteer emergency service (United States naval reserve) |
| W.C.T.U. | Woman's Christian Temperance union |
| WFA | war food administration |
| W.F.T U | World Federation of Trade Unions |
| W H O | World Health organization |
| WLB | War Labor board |
| WMC | War Manpower commission |
| WPA | Work Projects administration |
| WPB | War Production board |
| WRA | War Relocation authority |
| WRENS, W R.N S. | women's royal naval service |
| W.S. | writer to the signet (in Scotland) (equivalent to attorney) |
| WSA | War Shipping administration |
| wt. | weight |
| yd. | yard(s) |
| Y.M.C.A. | Young Men's Christian association |
| Y.M - Cath.A. | Young Men's Catholic association |
| Y M H.A. | Young Men's Hebrew association |
| Y.P S.C.E. | Young People's Society of Christian Endeavor |
| yr. | year(s); younger; your |
| Y.W C.A. | Young Womens Christian association |
| Y.W.H.A. | Young Women's Hebrew association |
| Z.S. | zoological society |

**ABBREVIATORS,** officials in the papal chancery, whose business was to draft the pope's bulls, briefs and consistorial decrees before these were written out *in extenso* by the *scriptores.* They are first mentioned in *Extravagantes* of John XXII. Pius II fixed their number at 70, and formed them into a college of prelates Pius VII reduced their number to 17. The college was abolished in 1908 by Pius X, who transferred its duties to the *Collegium Pronotariorum Apostolicorum.* (*See* CURIA ROMANA.)

**A.B.C. POWERS,** a designation which came into use shortly before World War I for the three leading South American powers—Argentina, Brazil and Chile. For many years previously a current of opinion had prevailed in several republics of South America favouring an alliance to counteract certain political tendencies of the United States and particularly the Monroe Doctrine. Recalling unsettled boundaries and other political problems, statesmen of certain Latin American republics had, from

time to time, provided for arbitration agreements or other means of mutual assistance in case of emergencies. Among such was the treaty between Brazil and Chile in 1899; between Argentina and Chile in 1902; and between Argentina and Brazil in 1905. These pacts have been regarded as the forerunners of the three-power *entente cordiale* that gradually developed and was discussed at the first Pan-American Scientific Congress, held at Santiago, Chile, in 1908–09. In 1915 Argentina, Brazil and Chile concluded among themselves a group of treaties of peace and arbitration

On April 25, 1914, when war between the United States and Mexico appeared imminent, the Governments of Argentina, Brazil and Chile, through their diplomatic representatives at Washington, Dr. Rómulo S Naón, Sr. Domicio da Gama, and Don Eduardo Suárez, respectively, addressed the secretary of State of the United States tendering their services as mediators. This mediation was accepted by President Woodrow Wilson, who appointed as United States delegates Justice Joseph R. Lamar and Frederick W. Lehmann, while Mexico chose as her representatives Sres. Emilio Rabasa, Augustin Rodriguez and Luis Elguero These A B.C. mediators, together with the Americans and the Mexicans, met in a series of sessions at Niagara Falls, Canada. The deliberations began on May 18, 1914, and were continued until August of the same year The result of the conference was thus summarized by the Brazilian delegate, Senhór da Gama, as follows: "We have established, through agreement between the parties most directly interested, and in complete harmony with the sentiments of the Government of the United States, that it is a principle of American policy to have our national problems always given a fair examination and settled without foreign interference" (W. A. R)

**ABDALLATIF** or ABD-UL-LATIF (1162–1231), physician and traveller, was born and died in Baghdad. A memoir of Abdallatif, written by himself, has been preserved with additions by Ibn-Abu-Osaiba (Ibn abī Usaibia), a contemporary. He visited Mosul, Damascus and Egypt and then joined the circle of learned men whom Saladin gathered around him at Jerusalem. He taught medicine and philosophy at Cairo and at Damascus for a number of years, and afterwards, for a shorter period, at Aleppo.

Of the numerous works—mostly on medicine—which Osaiba ascribes to him, one only, his graphic and detailed *Account of Egypt*, appears to be known in Europe. The manuscript, discovered by Edward Pococke, the Orientalist, and preserved in the Bodleian Library, contains a vivid description of a famine caused by the Nile failing to overflow its banks. It was translated into Latin by Professor White of Oxford in 1800 and into French, with valuable notes, by De Sacy in 1810.

**'ABD-AR-RAHMAN,** the name borne by five princes of the Omayyad dynasty, amirs and caliphs of Cordova.

'ABD-AR-RAHMAN I. (756–788) founded the branch of the family which ruled for nearly three centuries in Mohammedan Spain. When the Omayyads were overthrown in the East by the Abbasids, 'Abd-ar-Rahman ibn Moawya, grandson of the caliph Histrām, was a young man of about 20 years of age. Together with his brother Yahya, he took refuge with Bedouin tribes in the desert. The Abbasids hunted their enemies down without mercy. Yahya was slain, and 'Abd-ar-Rahman saved himself by fleeing first to Syria and thence to northern Africa which had fallen into the hands of local rulers, formerly amirs or lieutenants of the Omayyad caliphs, but now aiming at independence. In the midst of all his perils, which read like stories from the *Arabian Nights*, 'Abd-ar-Rahman had been encouraged by a prophecy of his great-uncle Maslama that he would restore the fortunes of the family. He was followed in all his wanderings by a few faithful clients of the Omayyads. In 755 he was in hiding near Ceuta, and he sent an agent over to Spain to ask for the support of other clients of the family, descendants of the conquerors of Spain, who were numerous, in the province of Elvira, the modern Granada. On the invitation of his partisans he landed at Almuñecar, to the east of Malaga, on Aug. 14, 755. In the course of 756 a campaign was fought in the valley of the Guadalquivir, which ended, on May 16, in the defeat of the emir Yūsuf outside Cordova. 'Abd-ar-Rahman's army was so ill provided that he mounted almost the only good war-horse in it; he had no banner, and one was improvised by unwinding a green turban and binding it round the head of a spear The turban and the spear became the banner of the Spanish Omayyads. Yūsuf recognized 'Abd-ar-Rahman as emir of Spain in July 756.

'ABD-AR-RAHMAN II. (822–852), son of the emir Hakam, was one of the weaker of the Spanish Omayyads He was a prince with a taste for music and literature.

'ABD-AR-RAHMAN III (912–961) was the greatest and the most successful of the princes of his dynasty in Spain He succeeded his grandfather 'Abdallāh when he was barely 22 and reigned for half a century. 'Abd-ar-Rahman III came to the throne when the country was exhausted by more than a generation of tribal conflict among the Arabs, and of strife between them and the Mohammedans of native Spanish descent. Spaniards who were openly or secretly Christians had acted with the renegades. These elements were not averse from supporting a strong ruler who would protect them against the Arab aristocracy. These restless nobles were the most serious of 'Abd-ar-Rahman's enemies. Next to them came the Fatimites of Egypt and northern Africa, who claimed the caliphate, and who aimed at extending their rule over the Mohammedan world, at least in the west. 'Abd-ar-Rahman subdued the nobles by means of a mercenary army, which included Christians. He repelled the Fatimites, partly by supporting their enemies in Africa and partly by claiming the caliphate for himself. His ancestors in Spain had been content with the title of sultan. The caliphate was thought only to belong to the prince who ruled over the sacred cities of Mecca and Medina But the force of this tradition had been so far weakened that 'Abd-ar-Rahman could proclaim himself caliph on Jan. 16, 929. His worst enemies were always his fellow Mohammedans. After he was defeated by the Christians at Alhandega in 939 through the treason of the Arab nobles in his army he never again took the field

In the agony of the Omayyad dynasty in Spain, two princes of the house were proclaimed caliphs for a very short time, 'Abd-ar-Rahman IV. Mortada (1017), and 'Abd-ar-Rahman V. Mostadir (1023–24). Both were the mere puppets of factions, who deserted them at once. 'Abd-ar-Rahman IV. was murdered in the year in which he was proclaimed, at Guadiz, when fleeing from a battle in which he had been deserted by his supporters. 'Abd-ar-Rahman V. was proclaimed caliph in Dec. 1023 at Cordova, and murdered in Jan. 1024 by a mob of unemployed workmen, headed by one of his own cousins.

The history of the Omayyads in Spain is the subject of the *Histoire des Musulmans d'Espagne* by R. Dozy (Leyden, 1861). *See* also SPAIN: *From* A.D. *406 to the Conquest of Granada.*

**ABD-EL-AZIZ IV.** (1878–1943), sultan of Morocco, son of Sultan Mulai el Hasan III. by a Circassian wife He was 16 years of age on his father's death in 1894. By the wise action of Si Ahmad bin Musa, the chamberlain of el Hasan, Abd-el-Aziz's accession to the sultanate was ensured with but little fighting. Si Ahmad became regent and for six years showed himself a capable ruler. On his death in 1900 the regency ended, and Abd-el-Aziz took the reins of government into his own hands, with an Arab from the south, el Menebhi, for his chief adviser. Urged by his Circassian mother, the sultan sought advice and counsel from Europe and endeavoured to act up to it. But disinterested advice was difficult to obtain, and in spite of the unquestionable desire of the young ruler to do the best for the country, wild extravagance both in action and expenditure resulted, leaving the sultan with depleted exchequer and the confidence of his people impaired. His intimacy with foreigners and his imitation of their ways were sufficient to rouse fanaticism and create dissatisfaction. Europeans were accused of having spoiled the sultan and of being desirous of spoiling the country. When British engineers were employed to survey the route for a railway between Mequinez and Fez this was reported as indicating an absolute sale of the country. The fanaticism of the people was aroused and a revolt broke out near the Algerian frontier. Such was the condition of things when the news of the Anglo-French Agreement of 1904 came as a blow to Abd-el-Aziz, who had relied

on England for support and protection against the inroads of France. On the advice of Germany he proposed the assembly of an international conference at Algeciras in 1906 to consult upon methods of reform, the sultan's desire being to ensure a condition of affairs which would leave foreigners with no excuse for interference in the control of the country. The sultan gave his adherence to the Act of the Algeciras Conference, but the state of anarchy into which Morocco fell during the latter half of 1906 and the beginning of 1907 exposed the weakness of his government. In May 1907 the southern tribes invited Mulai Hafid, an elder brother of Abd-el-Aziz, and viceroy at Marrakesh, to become sultan, and in the following August Hafid was proclaimed sovereign. In the meantime the murder of Europeans at Casablanca had led to the occupation of that port by France. In September Abd-el-Aziz arrived at Rabat from Fez to seek the support of the European powers against his brother. From France he was later enabled to negotiate a loan. His leaning to Christians aroused further opposition and in January 1908 he was declared deposed by the ulema of Fez, who offered the throne to Hafid. After months of inactivity Abd-el-Aziz made an effort to restore his authority, and quitting Rabat in July he marched on Marrakesh. His force was completely overthrown (Aug. 19) when near that city, and Abd-el-Aziz fled to Settat within the French lines round Casablanca. In November he came to terms with his brother, and thereafter took up his residence in Tangier as a pensioner of the new sultan. (*See* MOROCCO: *History.*)

**ABD-EL-KADER** (1807?–1883), amir of Mascara, the great opponent of the conquest of Algeria by France, was born near Mascara in 1807 or 1808. His family were *sherifs* or descendants of Mohammed, and his father, Mahi-ed-Din, was celebrated throughout north Africa for his piety and charity. Abd-el-Kader received an excellent education in theology and philosophy, in horsemanship and in other manly exercises. A pilgrimage to Mecca and Medina and to the tomb of Sidi Abd-el-Kader El Jalili at Baghdad stimulated his religious enthusiasm. While in Egypt in 1827, Abd-el-Kader was impressed by the reforms then being carried out by Mohammed Ali, and the knowledge he then gained affected his career. Mahi-ed-Din and his son returned to Mascara shortly before the French occupation of Algiers destroyed the government of the Dey (July 1830). Coming forward as the champion of Islam against the infidels, Abd-el-Kader was proclaimed amir at Mascara in 1832. In a short time he had rallied to his standard all the tribes of western Algeria. The story of his 15 years' struggle against the French is given under ALGERIA. Up to the beginning of 1842 the contest went in favour of the amir; thereafter he found in Marshal Bugeaud an opponent who proved, in the end, his master. Throughout this period Abd-el-Kader showed himself a born leader of men, a great soldier, a capable administrator, a persuasive orator, a chivalrous opponent. His ultimate failure was due in considerable measure to the refusal of the Kabyles, Berber mountain tribes whose Mohammedanism was somewhat loosely held, to make common cause with the Arabs against the French. On Dec. 21, 1847 Abd-el-Kader surrendered to General Lamoricière at Sidi Brahim. On the 23rd, his submission was formally made to the duc d'Aumale, then governor of Algeria. In violation of the promise that he would be allowed to go to Alexandria or St. Jean d'Acre, Abd-el-Kader and his family were detained in France, where he remained until Oct. 1852, when he was released by Napoleon III. on taking an oath never again to disturb Algeria. The amir then lived in Brusa, removing in 1855 to Damascus. In July 1860, when the Muslims attacked the Christian quarters of Damascus, Abd-el-Kader saved large numbers of Christians.

When the Algerians revolted, Abd-el-Kader, in 1871, counselled submission to France. After 1847 he composed a philosophical treatise, of which a French translation was published in 1858 under the title of *Rappel à l'intelligent, Avis à l'indifférent.* He also wrote a book about the Arab horse. He died at Damascus on May 26, 1883.

*See* Commdt. J. Pichon, *Abd el Kader, 1807–83* (1899); Alex. Bellemare, *Abd-el-Kader: sa vie politique et militaire* (1863); Col. C. H. Churchill, *The Life of Abdel Kader* (1867).

**ABDEL KRIM** (1881– ), Mohammed ben Abdel Krim el-Khatabe, a Moroccan chieftain, son of a caid of the Beni Uriaghel tribe in the mountainous country that extends inland from Alhucemas bay on the Rif coast of Morocco. His father was a person of no particular importance or family, but, being a man of progressive ideas and in contact with the Spaniards at Melilla, he gave his two sons an education to which few of the Riffian tribesmen aspire. While Mohammed, the future Riffian leader, was taught Spanish and a smattering of European knowledge, his brother, Mohammed, was sent to Spain and educated as a mining engineer. (It is customary among the peoples of northern Africa and Egypt to give brothers the same name if it is an illustrious one.) Abdel Krim was employed in the office of native affairs at Melilla, while his brother worked in the interests of certain mining groups.

In 1919 a quarrel between Abdel Krim and General Silvestre, of the Spanish army, led to the former's flight from Melilla. He took to the mountains of his tribe, where his brother joined him Both swore revenge, and instituted a fierce resistance to the occupation of the Rif by the Spaniards. In 1921 Abdel Krim avenged himself of the slight he had received from Silvestre. With only a few hundred tribesmen, he attacked the Spanish advanced post of Anual and captured it. Silvestre was killed, or committed suicide. The fall of Anual spread panic through the Spanish army of 19,000 men. The Spanish posts were deserted, and the troops fled in disorderly retreat. Before the fighting was ended 16,000 of the 19,000 men had been massacred. The remainder mostly crossed into the French zone. The Riffian tribesmen were guilty of every kind of treachery and atrocity, their revenge for acts of which they accused the Spaniards, more especially that of forcible interference with their women, an unpardonable offence in their eyes. The Rifi reached the walls of Melilla, and, had they chosen, they could have captured the town and massacred its population of 50,000 civilians. But glutted with bloodshed and loaded with loot, they desisted.

This signal defeat of the Spaniards vastly increased Abdel Krim's reputation amongst the tribes. The Jabala, inhabiting the western portion of the Spanish zone, joined his cause and in 1924 the Spaniards were obliged to abandon all their inland positions and retreat on Tetuan and the sea, suffering heavy losses in the retirement. By the end of that year Abdel Krim, having rid himself by capture of his only rival, Raisuli, was master of the situation, and set to work to prepare a fresh campaign against the Spaniards. But a new danger threatened him from the south. The French, gradually occupying the zone to which they laid claim under existing treaties, were advancing northward, and Abdel Krim was forced to go to the aid of the threatened tribes. His army and the revolted tribesmen invaded the French protectorate, and by June 1925 threatened Fez.

French reinforcements were hurriedly dispatched from France and Algeria, and by October the French protectorate territory was clear of the enemy, and a French army of 160,000 men, under Marshal Pétain, was on the borders of the Rif. In September the Spaniards had successfully disembarked a force in Alhucemas bay and Ajdir had been taken. By Nov. 1, 1925 the French and Spanish armies had been obliged by the weather to abandon an active campaign, and were digging themselves into winter quarters, but Abdel Krim, though weakened and threatened, was by no means beaten. This man of great ability and astounding energy fortified his mountain fastnesses and collected new forces to continue his campaign against two European armies, but in vain. He surrendered to France in May 1926, and was exiled to the island of Réunion. *See* MOROCCO: *History.*

*See* Walter Harris, *France, Spain and the Rif* (1927).

(W. B. H.)

**ABDERA,** ancient town, coast of Thrace, near the mouth of the Nestos, almost opposite Thasos. Its mythical foundation was attributed to Heracles; historically it was a colony from Clazomenae in the 7th century B.C. But its prosperity dates from 544 B.C., when the majority of the people of Teos migrated to Abdera to escape Persian oppression (Herod. i. 168). The town seems to have declined in importance after the middle of the 4th

century. The air of Abdera was proverbial as causing stupidity; but among its citizens was the philosopher Democritus. The ruins on Cape Balastra cover seven small hills, and extend from an east to a west harbour; on the south-west hills are remains of the mediaeval settlement of Polystylon.

See *Mittheil d. deutsch Inst Athens*, xii (1887), p 161 (Regel), *Mém. de l'Acad des Inscriptions* xxxiv 211, K F Hermann, *Ges Abh.* 90–111, 370 ff ; S Casson, *Macedon. Thrace and Illyria* (1926), Pauly-Wissowa, *s v.*

ABDERA, an ancient seaport on the south coast of Spain, between Malaga and New Carthage, in the district inhabited by the Bastuli Founded by the Carthaginians, it became an important town in the Roman province of Hispania Baetica. It was on a hill above the modern Adra (*q.v.*). Its most ancient coins bear the Phoenician inscription, *abdrt*, with the head of Heracles (Melkarth) and a tunny-fish; those of Tiberius (who seems to have made the place a colony) show the chief temple of the town with two tunny-fish erect in the form of columns.

ABDICATION, the act whereby a person in office renounces the same before the expiry of the time for which it is held. (Lat *abdicatio*, from *ab*, from, and *dicare*, to proclaim as not belonging to one) In Roman law, the term is especially applied to the disowning of a member of a family, as the disinheriting of a son, but the word is seldom used except in the sense of surrendering the supreme power in a State. Despotic sovereigns are at liberty to divest themselves of their powers at any time, but it is otherwise with a limited monarchy. The throne of Great Britain cannot be lawfully abdicated unless with the consent of the two houses of parliament. When James II fled in 1688, the question was discussed in parliament whether he had forfeited the throne or had abdicated. Later abdications include:

Pu-yi (China) Feb. 12, 1912; Nicholas II (Russia) March 15, 1917, Ferdinand I (Bulgaria) Oct. 3, 1918, William II (Germany) Nov 9, 1918; Frederick Augustus III (Saxony) Nov. 9, 1918, Charles I (Austria-Hungary) Nov. 12, 1918; Louis III (Bavaria) Nov 13, 1918, Frederick II (Baden) Nov. 22, 1918; William II (Wurttemberg) Dec. 2, 1918; George II (Greece) Dec. 18, 1923, but restored to the throne Nov. 1935; Edward VIII (Great Britain) Dec. 11, 1936; Carol II (Rumania) Sept 6 1940; Mihai (Michael) I (Rumania) Dec 30, 1947, Wilhelmina (Netherlands) Sept. 4, 1948.

ABDOMEN, the belly, the body cavity lying between the chest or thorax above and the pelvis below. The diaphragm is its upper boundary. There is no wall or clear-cut boundary between it and the pelvis. It contains organs of digestion and the spleen which are surrounded by the peritoneum which is a serous membrane. (*See* ANATOMY; ALIMENTARY CANAL.)

**ABDOMEN, SURGERY OF.** The diseases of this region are dealt with generally in the article ALIMENTARY SYSTEM, DISEASES OF THE, and under their own names (*e.g.*, APPENDICITIS). For the surgery of each abdominal organ *see* STOMACH; KIDNEY, DISEASES OF; LIVER AND GALL-BLADDER, DISEASES OF, etc.

**Exploratory Laparotomy.**—In many cases of intra-abdominal disease the surgeon cannot say what is wrong without making an incision and examining by sight or touch. Under conditions of strict asepsis this is not a perilous or serious procedure. When an opening is made in such circumstances—provided only it is done soon enough—the successful treatment of the case often becomes a simple matter.

A great impetus was given to the surgery of wounded, mortified, or diseased pieces of intestine by the introduction from Chicago of a contrivance named, after the inventor, *Murphy's button*. This consists of a short nickel-plated tube in two pieces, which are secured in the divided ends of the bowel so that when the pieces are subsequently "married" the adjusted ends of the bowel are securely fixed together and the canal rendered practicable. In the course of time the button loosens itself into the interior of the bowel and comes away with the motions. In many other types of case the button has proved convenient and successful, but sometimes ulceration occurs around the rim of the metal button, or the loosened metal causes trouble in its passage along the alimentary canal. Some surgeons therefore prefer a bobbin of decalcified bone or similar soft material, while others rely upon direct suturing of the parts. The last-named method has increased in favour The cause of death in intestinal obstruction is usually absorption of poisonous substances formed in the bowel above the obstruction. Usually, therefore, the surgeon completes his operation for the relief of obstruction by drawing out a loop of the distended bowel, incising and evacuating it, and then carefully suturing and returning it.

Rectal or subcutaneous injections of saline or other fluid and early adoption of a sitting position for the patient are other measures often adopted.

**Wounds of the Abdomen.**—The treatment of gunshot wounds of the abdomen differs according to circumstances. If the wound be caused by a rifle bullet travelling at high speed, the intra-abdominal pressure is usually sufficient to prevent escape of intestinal contents; complete rest and avoidance of surgery is the procedure of choice, and the chance of recovery is great though several coils of intestine may have been pierced But if the wound be caused by a fragment of high explosive shell, or a revolver shot or a stab this is not the case To avoid the onset of peritonitis, early operation, suture of the wounded gut and washing out of the peritoneal cavity afford the only chance for the patient. The "expectant" treatment which proved best in the South African War (1899–1902) was at first followed in the World War, but soon was abandoned in favour of laparotomy.

**Intussusception.**—This is a terribly fatal disease of infants and children, in which a piece of bowel slips into, and is gripped by, the piece next below it. Formerly attempts were made to reduce the invagination by passing air or water up the rectum under pressure, but now early recourse is had to abdominal surgery with far better results

**Cancer of the Intestine.**—With the introduction of aseptic surgery the bowel can be reached through the peritoneum easily and safely. If the cancerous mass is fairly movable the affected piece of bowel is excised, the cut ends are united and the continuity of the alimentary canal is re-established. When the lowest part of the bowel was found to be cancerous, the surgeon used formerly to secure an escape for the contents of the bowel by making an opening into the colon in the left loin. But in recent years this operation of *lumbar colotomy* has been almost entirely replaced by opening the colon in the left groin.

ABDUCTION, a law term denoting the forcible or unlawful removal of a person. The Offences against the Person Act 1861, by s. 53, makes it felony for any one from motives of lucre to take away or detain against her will, with intent to marry or carnally know her, etc., any woman of any age who has any interest in any real or personal estate, or is an heiress presumptive, or co-heiress, or presumptive next of kin to any one having such an interest; or for any one to cause such a woman to be married or carnally known by any other person; or for any one with such intent to allure, take away, or detain any such woman under the age of 21, out of the possession and against the will of her parents or guardians. By s. 54, forcible taking away or detention against her will of any woman of any age with like intent is felony. The same act, by s. 55, makes abduction without even any such intent a misdemeanour, where an unmarried girl under the age of 16 is unlawfully taken out of the possession and against the will of her parents or guardians. The girl's consent is immaterial, nor is it a defence that the person charged reasonably believed that the girl was 16 or over. By s. 56, stealing a child under the age of 14 with intent to deprive parents or guardian of such child is also a felony. The Criminal Law Amendment Act 1885 made still more stringent provisions with reference to abduction by making the procuration or attempted procuration of any virtuous female under the age of *twenty-one years* a misdemeanour, as well as the abduction of any girl under *eighteen years* of age with the intent that she shall be carnally known, or the detaining of *any female* against her will on any premises, with intent to have, or that another person may have, carnal knowledge of her.

In the United States, in some of the States, mere unchastity is no defence. The burden of proof is on the defendant that the woman abducted was unchaste, the presumption of her chastity standing unless otherwise proved.

**ABDUL AZIZ** (ahbd-o͝ol ah-zēz) (1830–1876), sultan of Turkey, second son of Sultan Mahmud II, was born Feb 9, 1830, and succeeded his brother Abdul-Mejid as sultan 1861. He took advantage of the constant issue of state loans to acquire wealth which was squandered extravagantly, and received large sums from Ismail Pasha, the khedive of Egypt, for signing the firman of 1866, which made succession to the khedivate hereditary from father to son in direct line, as well as subsequent firmans of 1867, 1869 and 1872, extending the khedive's prerogatives. In 1870 Abdul Aziz signed the firman creating the Bulgarian exarchate, thus separating the Bulgarian church from the Greek church at Constantinople. The insurrection of 1875 in Bosnia and Hercegovina and the abortive revolts in Bulgaria (Sept. 1875 and May 1876) together with the sultan's incapacity and extravagance in Turkey itself caused an outbreak of Moslem discontent and fanaticism culminating in the Bulgarian atrocities, and in the murder of two consuls at Salonika. Abdul Aziz was deposed May 29, 1876, by a group of prominent politicians, and his death, four days later, is attributed to suicide.

Abdul Aziz was the first Ottoman sultan to visit western Europe (1867).

**ABDUL-HAMID I** (1725–1789), sultan of Turkey, son of Ahmed III, succeeded his brother Mustafa III in 1773, and died on April 7, 1789. For the disastrous wars with Russia which marked his reign *see* TURKEY.

**ABDUL-HAMID II** (1842–1918), sultan of Turkey, son of Sultan Abdul-Mejid, was born on Sept. 21, 1842, and succeeded to the throne on the deposition of his brother, Murad V, on Aug. 31, 1876. He was brought to power by the group of liberals, led by Midhat Pasha, that had deposed his predecessor; and he inaugurated his reign by proclaiming a constitution. The first Ottoman parliament met on Dec. 23, 1876, the very day that the conference of the great powers in Constantinople began its deliberations. But the circumstances of the country at his accession were ill-adapted for liberal developments.

An empty treasury, the revolts in Serbia and Montenegro, the feeling aroused throughout Europe by the savage methods adopted in stamping out the Bulgarian rebellion, all combined to prove to the new sultan that he could expect little aid from the powers. But he obstinately opposed the pressing requests of the powers that the necessary reforms should be instituted. In 1878 the constitution was suspended. The exile in 1880 and the death in 1884 of Midhat followed, and a dictatorship was established which lasted until 1908.

Early in 1877 the disastrous war with Russia began. The hard terms, embodied in the treaty of San Stefano, to which Abdul-Hamid was forced to consent, were to some extent amended at Berlin, thanks in the main to British diplomacy (*see* EUROPE: *History*); but by this time the sultan had lost all confidence in England and thought that he discerned in Germany the future friend of Turkey. He employed Germans to reorganize his finances and army and determined to suppress all liberal tendencies and gradually to take the reins of absolute power into his own hands. Financial embarrassments forced him to consent to foreign control over the debt and to issue the decree of Dec. 1881, under which many of the revenues of the empire were handed over to the public debt administration for the benefit of the bondholders. Trouble in Egypt, where a discredited khedive had to be deposed, and trouble on the Greek frontier and in Montenegro, where the powers were determined that the decisions of the Berlin congress should be carried into effect, were more or less satisfactorily overcome. In his attitude toward Arabi, the would-be saviour of Egypt, Abdul-Hamid showed less than his usual astuteness, and the resulting consolidation of England's hold over the country contributed still further to his estrangement from Turkey's old ally. In 1881 the French occupied Tunisia. The union in 1885 of Bulgaria with Eastern Rumelia was another blow.

For several years the sultan preserved toward Bulgaria an attitude skilfully calculated to avoid running counter either to Russian or to German wishes. Germany's friendship was not entirely disinterested and had to be fostered with a railway or loan concession from time to time, until in 1899 the Baghdad railway was conceded.

Meanwhile the sultan had succeeded in reducing his ministers to the position of secretaries and in concentrating the whole administration of the country into his own hands at Yildiz But internal dissension was not thereby lessened. Crete was constantly in turmoil, the Greeks were dissatisfied, and from about 1890 the Armenians began a violent agitation with a view to obtaining the reforms promised them at Berlin. Minor troubles had occurred in 1892 and 1893 at Marsovan and Tokat. In 1894 a more serious rebellion in the mountainous region of Sassun was ruthlessly stamped out. The powers insistently demanded reforms, the eventual grant of which in the autumn of 1895 was the signal for a series of massacres in the Armenian provinces and in Constantinople itself.

The reforms became more or less a dead letter. Crete indeed profited by the grant of extended privileges, but these did not satisfy its turbulent population, and early in 1897 a Greek expedition sailed to unite the island to Greece. War followed, in which Turkey was easily successful and gained a small rectification of frontier; then a few months later Crete was taken over *en dépôt* by the Four Powers (Germany and Austria not participating) and Prince George of Greece was appointed their mandatory. In the next year the sultan received the visit of the German emperor and empress.

Abdul-Hamid had always resisted the pressure of the European powers to the last moment, in order to seem to yield only to overwhelming force, while posing as the champion of Islam against aggressive Christendom. Pan-Islamic propaganda was encouraged; the privileges of foreigners in the Ottoman empire (often an obstacle to government) were curtailed; the new railway to the Holy Places was pressed on, and emissaries were sent to distant countries preaching Islam and the caliph's supremacy. This appeal to Moslem sentiment was, however, powerless against the disaffection due to perennial misgovernment.

In Mesopotamia and Yemen disturbance was endemic; nearer home, a semblance of loyalty was maintained in the army and among the Moslem population by a system of delation and espionage and by wholesale arrests; while, obsessed by terror of assassination, the sultan withdrew himself into fortified seclusion in the palace of Yildiz.

**Macedonian Crisis.**—The humiliation of the situation in Macedonia (*q.v.*), together with the resentment in the army against the palace spies, brought matters to a crisis. The remarkable revolution associated with the names of Niazi Bey and Enver Bey, the Young Turk leaders, and the Committee of Union and Progress is described elsewhere (*see* TURKEY: *History*); here it must suffice to say that Abdul-Hamid, on learning of the threat of the Salonika troops to march on Constantinople (July 22), at once capitulated. On July 24 an *iradé* announced the restoration of the suspended constitution of 1876 and a Young Turk government was formed; next day, further *iradés* abolished espionage and the censorship and ordered the release of political prisoners. On Dec. 10 the sultan opened the Turkish parliament with a speech from the throne in which he said that the first parliament had been "temporarily dissolved until the education of the people had been brought to a sufficiently high level by the extension of instruction throughout the empire."

The correct attitude of the sultan did not save him from the suspicion of intriguing with the powerful reactionary elements in the state, a suspicion confirmed by his attitude toward the counter revolution of April 13, when an insurrection of the soldiers and the Moslem populace of the capital overthrew the committee and the ministry. The committee, restored by the Salonika troops, now decided on Abdul-Hamid's deposition, and on April 27 his brother Reshid Effendi was proclaimed sultan as Mohammed V. The former sultan was confined at Salonika.

When Salonika capitulated to the Greeks in the Balkan War (1912) Abdul-Hamid was brought back to Constantinople. In 1915 he was removed to Magnesia, in Asia Minor, where he died on Feb. 10, 1918.

*See* Sir E. Pears, *Life of Abdul-Hamid* (London, 1917); C. Hacquard, *La Turquie sous Abdul-Hamid II* (Brussels, 1901).

**ABDULINO,** town in the Chkalov region of the Russian S.F.S.R. Pop. 13,690. It is on the boundary between Kuibyshev and Bashkiria on the Uk river, north of the railway from Kuibyshev to Ufa, and is a market for local products.

**ABDUL MEJID** (ahbd-ōōl mĕ-jēd′) (1823–1861), sultan of Turkey, was born April 23, 1823, and succeeded his father, Mahmud II., on July 2, 1839. Mahmud appears to have been unable to effect the reforms he desired in the mode of educating his children, so that his son received no better education than that usually given to Turkish princes in the harem. Abdul Mejid succeeded to the throne at a moment of crisis. The news was on its way to Constantinople that the Turkish army had been defeated at Nezib by that of the rebel Egyptian viceroy, Mohammed Ali; and the Turkish fleet was on its way to Alexandria, where it was handed over by its commander, Ahmed Pasha, to the enemy, on the pretext that the young sultan's advisers were sold to Russia. Through the intervention of the European Powers Mohammed Ali was obliged to come to terms, and the Ottoman Empire was saved. *See* MOHAMMED ALI.

Abdul Mejid set at once about carrying out the reforms to which Mahmud had devoted himself. In Nov. 1839 was proclaimed an edict, known as the Tanzimāt, or Hatt-i-sherif of Gulhané, consolidating and enforcing these reforms; this was supplemented at the close of the Crimean War by a similar statute issued in Feb. 1856. These enactments provided that all classes of the sultan's subjects should have security for their lives and property; that taxes should be fairly imposed and justice impartially administered; and that all should have full religious liberty and equal civil rights. The scheme was opposed by the governing classes and the *ulema,* or privileged religious teachers, and was but partially put in force, especially in the remoter parts of the empire; and more than one conspiracy was formed against the sultan's life on account of it.

Of the other measures of reform promoted by Abdul Mejid the more important were: the institution of a council of public instruction (1838), the reorganization of the army (1843–44), and of a ministry of public instruction (1857), the abolition of an odious and unfairly imposed capitation tax, the repression of slave trading, and various provisions for the better administration of the public service and for the advancement of commerce, including the establishment of a mixed commercial court at Constantinople. For the general history of his times—the disturbances and insurrections in different parts of his dominions throughout his reign, and the great war successfully carried on against Russia by Turkey, and by Britain, France and Sardinia, in the interest of Turkey (1853–56)—*see* TURKEY and CRIMEAN WAR. When Kossuth and others sought refuge in Turkey, after the failure of the Hungarian rising in 1849, the sultan refused to surrender them. It is to his credit, too, that he would not allow the conspirators against his own life to be put to death. He was described as a kind and honourable man, if somewhat weak and easily led.

His extravagance, especially towards the end of his life, was excessive. He died on June 25, 1861, and was succeeded by his brother, Abdul Aziz (*q.v.*), as the oldest survivor of the family of Osman. He left several sons, of whom two, Murad V. and Abdul Hamid II., eventually succeeded to the throne.

**ABDUR RAHMAN KHAN** (*c.* 1844–1901), amir of Afghanistan, was the son of Afzul Khan, eldest son of the amir Dost Mohammed Khan (*q.v.*). Before his death in 1863, Dost Mohammed had nominated as his successor Sher Ali, his third son, passing over the two elder brothers, Afzul Khan and Azim Khan; and at first the new amir was quietly recognized. But after a few months Afzul Khan raised an insurrection in the northern province, between the Hindu Kush mountains and the Oxus, where he had been governing when his father died; and then began a fierce contest for power among the sons of Dost Mohammed which lasted for nearly five years. In this war Abdur Rahman soon became distinguished for ability and daring energy. Although his father, Afzul Khan, who had none of these qualities, came to terms with the amir Sher Ali, the son's behaviour in the northern province soon excited the amir's suspicion, and Abdur Rahman, when he was summoned to Kabul, fled across the Oxus into Bukhara. Sher Ali threw Afzul Khan into prison, and a serious revolt followed in south Afghanistan; but the amir had scarcely suppressed it when Abdur Rahman's reappearance in the north was a signal for a mutiny of the troops stationed in those parts and a gathering of armed bands to his standard. After some delay and desultory fighting, he and his uncle Azim Khan occupied Kabul (Feb. 1866).

The amir Sher Ali marched against them from Kandahar; but in the battle that ensued at Sheikhabad on May 9, he was deserted by a large body of his troops and was defeated. Abdur Rahman then released his father, Afzul Khan, from prison in Ghazni and installed him as amir of Afghanistan.

Notwithstanding the new amir's incapacity and some jealousy between the real leaders, Abdur Rahman and his uncle, they again routed Sher Ali's forces and occupied Kandahar in 1867; and when at the end of that year Afzul Khan died, Azim Khan succeeded to the rulership, with Abdur Rahman as his governor in the northern province.

But toward the end of 1868 Sher Ali's return and a general rising in his favour, resulting in their defeat at Zurmat on Jan. 3, 1869, forced them both to seek refuge in Persia, from where Abdur Rahman proceeded afterward to place himself under Russian protection at Samarkand. Azim died in Persia in Oct. 1869. At the end of the second Afghan War, in 1880, Abdur Rahman was recognized by the British as amir of Kabul.

In 1893 the amir showed his usual ability in the settlement of the frontier question with Sir Mortimer Durand's mission. Abdur Rahman died on Oct. 1, 1901, being succeeded by his son Habibullah. (*See* AFGHANISTAN: *History.*)

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**À BECKETT, GILBERT ABBOTT** (1811–1856), English humorous writer, was born in north London on Jan. 9, 1811. He belonged to a family claiming descent from the father of St. Thomas Becket. His elder brother, Sir William à Beckett (1806–1869), became chief justice of Victoria (Australia). Gilbert Abbott à Beckett was educated at Westminster School, was called to the bar at Gray's Inn in 1841, and in 1849 became a metropolitan police magistrate.

He edited *Figaro in London,* and was one of the original staff of *Punch* and a contributor all his life. He produced some 50 or 60 plays, among them dramatized versions of Dickens' shorter stories in collaboration with Mark Lemon. He died at Boulogne Aug. 30, 1856.

His eldest son, GILBERT ARTHUR À BECKETT (1837–1891) was born at Hammersmith on April 7, 1837. On leaving Christ Church, Oxford, he was entered at Lincoln's Inn, but gave his attention chiefly to the drama, producing *Diamonds and Hearts* at the Haymarket in 1867, which was followed by other light comedies.

His pieces include numerous burlesques and pantomimes, the libretti of *Savonarola* (Hamburg, 1884) and of *The Canterbury Pilgrims* (Drury Lane, 1884) for the music of Dr. (afterward Sir) C. V. Stanford. *The Happy Land* (Court Theatre, 1873), a political burlesque of W. S. Gilbert's *Wicked World,* was written in collaboration with F. L. Tomline. For the last ten years of his life he was on the regular staff of *Punch.* He died on Oct. 15, 1891.

A younger son, ARTHUR WILLIAM À BECKETT (1844–1909), a well-known journalist and a man of letters, was also on the staff of *Punch* from 1874–1902, and gave an account of his father and his own reminiscences in *The À Becketts of Punch* (1903). He died in London on Jan. 14, 1909.

*See* also M. H. Spielmann, *The History of Punch* (1895).

**ABEDNEGO,** the name given in Babylon to Azariah, one of the companions of Daniel (Dan. i. 7, etc.). Probably a corruption of Abednebo, "servant of Nebo," or perhaps of Abednergo for Abednergal, "servant of the god Nergal."

**ABEKEN, HEINRICH** (1809–1872), German theologian and Prussian official, was born at Berlin on Aug. 3, 1809. In 1848

he entered the Prussian ministry for foreign affairs and in 1853 was promoted to be privy councillor of legation (Geheimer Legationsrath). He was employed by Bismarck in the writing of official despatches and often accompanied King William on his journeys as representative of the foreign office and was with him during the campaigns of 1866 and 1870–71.

See *Heinrich Abeken, ein schlichtes Leben in bewegter Zeit* (1898), by his widow. English translation by Mrs. C. E. Barrett-Lennard and M. W. Hofer (with portraits 1911). This is valuable by reason of the letters written from the Prussian headquarters.

**ABEL** (Hebrew Hebel, *breath*), second son of Adam, slain by Cain, his elder brother (Gen. iv, 1–15). The narrative in Genesis is supplemented in the New Testament ("By faith Abel offered unto God a more excellent sacrifice than Cain," Heb. xi, 4; Cain slew Abel "because his own works were evil, and his brother's righteous," 1 John iii, 12). The name probably means "herdsman" (*cf.* Jabal), as distinguished from the agriculturist Cain Possibly Abel was originally a South Judaean demigod or hero; *see* Winckler, *Gesch. Israels,* ii, p. 189; E. Meyer, *Israeliten,* p. 395. Augustine (*De Haeresibus,* lxxxvii) mentions a sect of *Abelitae,* in northern Africa.

**ABEL, JOHN JACOB** (1857–1938), U.S. pharmacologist and physiological chemist, was born in Cleveland, O., on May 19, 1857. He began life as a teacher and in 1879–82 was a principal and superintendent of schools in Indiana. In 1883 he graduated from the University of Michigan and, after a year at Johns Hopkins university, he devoted six years (1884–90) to the study of chemistry and medicine at Berlin, Strasbourg, Vienna and other European universities. He was lecturer on materia-medica in the University of Michigan in 1890–91 and then entered the faculty of Johns Hopkins university where in 1893 he became professor of pharmacology and physiological chemistry. He made extensive investigations of the chemical composition of animal tissues and fluids and also of the function and isolation of special chemical principles of the animal organism. A noteworthy example of the latter was his isolation of the blood-pressure-raising constituent of [illegible] glands (epinephrine) in the form of a benzoyl [illegible] made researches also on carbamic acid, the action of phthaleins, the poisons of mushrooms, albumoses in the tissues, hydrolytic products of proteins, histamin, insulin and various related subjects, in connection with which he has published many important papers. Two of his contributions to medical science were the isolation of adrenalin and the isolation of insulin in crystal form.

**ABEL, KARL FRIEDRICH** (1725–87), German musician, was born in Cöthen and died in London, where he lived during the greater part of his career. He was a great player on the viola da gamba, composed much music for that instrument and was one of the most prominent figures in the London musical life of his day. He studied under Johann Sebastian Bach at the Leipzig Thomasschule; played for ten years (1748–58) under A. Hasse in the band formed at Dresden by the elector of Saxony; and then, going to England, became (in 1759) chamber-musician to Queen Charlotte. The friendship between Johann Christian Bach, 11th son of Sebastian, who had also settled in London, and Abel led, in 1764 or 1765, to the establishment, at first under the auspices of the notorious Mrs. Cornelys, of the famous concerts subsequently known as the Bach and Abel concerts. The Hanover Square rooms were opened, on Feb. 1, 1775, by one of these concerts, at which, too, Haydn's symphonies were first performed in England. He was a man of striking presence, as several fine portraits, including two by Gainsborough, attest.

**ABEL, NIELS HENRIK** (1802–1829), Norwegian mathematician, was born at Findoe on Aug. 5, 1802, and died at Froland. One of the major creators of modern mathematics, Abel gave 19th century algebra, analysis and logical rigour some of their strongest impulses. The second of seven children of an impecunious pastor, he grew up in such poverty that his constitution was weakened irreparably, and he died of tuberculosis in his 27th year. Through all his poverty and illness he retained his courage and geniality. Poor himself, he shared what little he earned with his widowed mother and brothers and sisters.

Abel discovered his extraordinary mathematical talent when he was about 15, and within a year was mastering the works of Isaac Newton, Leonhard Euler, Carl Gauss and Joseph Lagrange. Somewhat shocked by the naive formalism of Euler's infinite algorithms, he made it one of his main projects to remedy the logical defects in the analysis of his time. He thus became one of the first rigourists and one of the most influential. His was the first satisfactory proof, for example, of the general binomial theorem. His discussion of convergence opened a new era in analysis. Prompted by his teacher, B. M. Holmboë (who in 1839 edited the first edition of Abel's works), he attempted the algebraic solution of the general quintic, and believed he had succeeded. When he realized his mistake, he conceived the revolutionary idea of trying to prove the impossibility of an algebraic solution. He succeeded. This is one of the outstanding landmarks in the methodology of mathematics.

On the completion of his course at the University of Kristiania (Oslo) in June 1822, he was subsidized by the Norwegian government so that he might continue his researches. In Aug. 1825, his mathematical friends persuaded the government, then having severe financial difficulties of its own, to grant him sufficient funds for a year's travel and study in France and Germany. He had planned to call on Gauss, to whom he had sent a copy of his memoir on the quintic; but hearing that Gauss had tossed it aside with the exclamation, "Here is another of those monstrosities!", he revised his plans. While in Berlin, he had the good fortune to meet A. L. Crelle (*q.v.*), who urged him to proceed with his epoch-making creation of the theory of elliptic functions. Although Abel's mathematics was beyond Crelle's understanding, he sensed that he was dealing with a mathematician of the first rank, and published many of Abel's papers in the first volumes of his great *Journal.*

Distracted by the sociability of Berlin, Abel sought seclusion at Freiburg. There he organized his masterpiece, *Memoir on a General Property of a Very Extensive Class of Transcendental Functions.* This work is concerned with algebraic functions and their integrals; it started one of the most extensive departments of mathematical analysis of the 19th century, and was responsible for a vast development of algebraic geometry.

Late in July 1826, Abel went to Paris, where he was politely received. His masterpiece was presented to the Paris Academy of Sciences in Oct. 1826, where it was mislaid till 1841, when it was recovered after an enquiry by a representative of the Norwegian government and published. During the printing, the original manuscript was lost. The main result in the memoir, known as "Abel's theorem," was described as "only a marvellous exercise in the integral calculus." As such, it revealed mathematical genius of a new order. Adrien Legendre, who generously encouraged Abel, described the theorem (in the words of Horace) as *monumentum aere perennius.*

By May 1827, Abel was destitute. He returned to Kristiania, fatally ill. The professorship he had hoped to obtain at the university had been reluctantly taken by Holmboë at the insistence of the government. His last days were spent at Froland, in the house of an English family where his fiancée was governess. "I will fight for my life!" he shouted in his delirium. He died on April 6, 1829. Two days after his death, Crelle wrote to say that he had succeeded in getting Abel appointed to the professorship of mathematics in the University of Berlin. (E. T. B.)

**ABÉLARD, PETER** (1079–1142), scholastic philosopher, was born in Pallet (Palais), not far from Nantes, in 1079. He was the eldest son of a noble Breton house. He studied first under Roscelin, the extreme nominalist, and then went to the cathedral school of Notre Dame, whose master was William of Champeaux, the disciple of St. Anselm, and most advanced of realists. After a short time he overcame the master in discussion, and thus began a long duel that issued in the downfall of the philosophic theory of realism, till then dominant in the early middle ages.

When William procured his expulsion from Paris, he set up a school of his own at Melun, whence he removed to Corbeil, nearer

Paris, finally becoming master of the school of St. Geneviève. He next turned to theology and attended the lectures of Anselm at Laon. His triumph over the theologian was complete; the pupil was able to give lectures, without previous training or special study, which were more popular than those of the master Abélard was now at the height of his fame. In 1115 he was made canon and master of Notre Dame, whither the fame of his learning and his personal charm drew students from all countries. (Fulk of Deuil, *Ep. ad Abaelardum.*)

Few teachers ever held such sway as Abélard now did for a time; but a change in his fortunes was at hand. He fell in love with the beautiful and learned Héloise, niece of Canon Fulbert, and seduced her. After the birth of their son, they were secretly married, though Héloise appealed to Abélard not to sacrifice his independence and chances of advancement. When the marriage became known, Héloise retired to the convent of Argenteuil Fulbert, believing that Abélard planned to be rid of her, took a barbarous revenge, breaking into his chamber by night and perpetrating upon him the most brutal mutilation. Abélard, in despair, became a monk at St Denys, and Héloise took the veil.

After a year Abélard opened a school of theology at the priory of Maisoncelle (1120). His lectures were heard again by crowds of students, and all his old influence seemed to have returned, but old enmities were revived also. His adversaries fell foul of his rationalistic interpretation of the Trinitarian dogma. Charging him with the heresy of Sabellius in a provincial synod held at Soissons in 1121, they procured a condemnation of his teaching, made him burn his book and shut him up in the convent of St. Médard at Soissons. When he returned to St. Denys, another dispute arose. He cited Bede to prove that Dionysius the Areopagite had been bishop of Corinth and not, as the monks held, bishop of Athens. When this historical heresy led to the inevitable persecution, Abélard withdrew to a desert place near Nogent-sur-Seine and turned hermit. His retreat becoming known, students flocked to him from Paris, and in gratitude for the consolation they brought him, he consecrated the new oratory they built for him by the name of the Paraclete.

Upon the return of new dangers, or at least of fears, Abélard accepted an invitation to preside over the abbey of St. Gildas de Rhuys, in Lower Brittany. The abbey was poor, disorderly and depraved, yet for nearly ten years he endured it, and it was only under peril of violent death that he fled from his charge. Meanwhile he had been able, on the breaking up of Héloise's convent at Argenteuil, to establish her as head of a new religious house at the deserted Paraclete. After his flight from St. Gildas, he wrote, among other things, his famous *Historia Calamitatum,* and thus moved Héloïse to pen her three *Letters,* which have kept their place among the great love letters of the world. In 1136 he was lecturing on Mount St. Geneviève (when he was heard by John of Salisbury), but it was only for a brief space. As far back as the Paraclete days he had been the opponent of Bernard of Clairvaux, who upheld the principle of fervent and unhesitating faith, from which rational inquiry like his was sheer revolt, and Abélard now came into conflict with this uncompromising spirit. In 1141 a council met at Sens, before which Abélard, formally arraigned upon a number of heretical charges, was prepared to plead his cause; but when Bernard had opened the case, suddenly Abélard appealed to Rome. The stroke availed him nothing; for Bernard, who had power, notwithstanding, to get a condemnation passed at the council, did not rest till a second condemnation was procured at Rome in the following year. Meanwhile, on his way thither to urge his plea in person, Abélard had broken down at the abbey of Cluny; and there, an utterly fallen man, only not bereft of his intellectual force, he lingered but a few months. Removed for the relief of his sufferings to the priory of St. Marcel, near Chalon-sur-Saone, he died April 21, 1142. Héloïse died in 1164, and the two now lie in the well-known tomb in the cemetery of Père Lachaise in Paris.

Great as was the influence exerted by Abélard on the minds of his contemporaries and the course of mediaeval thought, he has been little known in modern times but for his relations with Héloïse. Indeed, it was not till 1836, when Cousin issued the collection entitled *Ouvrages inédits d'Abélard,* that his philosophical performance could be judged at first hand; of his strictly philosophical works only one, the ethical treatise *Scito te ipsum,* having been published earlier (1721). Cousin's collection, besides giving extracts from the theological work, *Sic et Non* (an assemblage of opposite opinions on doctrinal points, culled from the Fathers as a basis for discussion, the main interest in which lies in the fact that there is no attempt to reconcile the different opinions), includes the *Dialectica,* commentaries on logical works of Aristotle, Porphyry and Boethius, and a fragment, *De Generibus et Speciebus,* which, with the psychological treatise *De Intellectibus* (published apart by Cousin in *Fragmens Philosophiques,* vol. ii) is now considered upon internal evidence not to be by Abélard himself. A genuine work, the *Glossulae super Porphyrium,* from which Charles de Rémusat, in his classical monograph *Abélard* (1845), has given extracts, remains in manuscript.

The general importance of Abélard lies in his having fixed more decisively than anyone before him the scholastic manner of philosophizing, with its object of giving a formally rational expression to the received ecclesiastical doctrine. However his own particular interpretations may have been condemned, they were conceived in essentially the same spirit as the general scheme of thought afterwards elaborated in the 13th century with approval from the heads of the church. Through him was prepared the ascendancy of the philosophical authority of Aristotle, which became firmly established in the half-century after his death, when first the completed *Organon,* and gradually all the other works of the Greek thinker, came to be known in the schools; before his time it was rather upon the authority of Plato that the prevailing realism sought to lean. As regards his so-called conceptualism and his attitude to the question of universals, *see* SCHOLASTICISM.

Outside of his dialectic, it was in ethics that Abélard showed greatest activity of philosophical thought, laying very particular stress upon the subjective intention as determining, if not the moral character, at least the moral value, of human action. His thought in this direction, wherein he anticipated something of modern speculation, is the more remarkable because his scholastic successors hardly ventured to bring the principles and rules of conduct under pure philosophical discussion, even after the ethical inquiries of Aristotle became known to them.

BIBLIOGRAPHY.—Abélard's own works remain the best sources for his life, especially his *Historia Calamitatum,* an autobiography, and the correspondence with Héloise. Charles de Rémusat's *Abélard* (1845) remains an authority; it must be distinguished from his drama *Abélard* (1877). McCabe's life of Abélard is written closely from the sources. *See* also U. Chevalier, *Répertoire des sources hist. du moyen âge,* "Abailard," (bibl.), and H. Rashdall, *Universities of Europe in the Middle Ages* (Oxford, 1895). A new translation of the famous *Letters* of Héloise, by George Moore, appeared in 1926.

**ABELIN, JOHANN PHILIPP,** (d. *c.* 1635) German chronicler. He wrote numerous histories over the pseudonyms of Philipp Arlanibäus, Abeleus and Johann Ludwig Gottfried or Gotofredus. His best known work is the *Theatrum Europaeum,* a series of chronicles of the chief events in the history of the world down to 1619. He compiled the first two volumes. It was continued by various writers and grew to 21 volumes (Frankf. 1633–1738). The chief interest of the work is its illustration by the beautiful copperplate engravings of Matthäus Merian (1593–1650).

*See* G. Droysen, *Arlanibaeus, Godofredus, Abelinus* (1864); and notice in *Allgemeine Deutsche Biographie.*

**ABELL, SIR WESTCOTT STILE** (1877– ), naval engineer. He was professor of naval architecture at Liverpool university, 1910–14, and chief ship surveyor at Lloyd's Register of Shipping from 1914 to 1928, when he was appointed professor of naval architecture at Armstrong college, Newcastle-upon-Tyne. A member of various boards, including two committees of the Board of Trade, on the Internationalization of the Load Line of Ships in 1913, and on Shipping and Shipbuilding in 1916, he became technical adviser to Controller of Shipping in 1917 and was president of the Institute of Marine Engineers 1924–25. He was created K.B.E. in 1920. Writings include *The Ship and her Work.*

**ABEL OF BETH-MAACAH,** a city in Maacah, one of the genuinely "Israelite" cities (*see* 2 Sam. xx, 18). The question of the Aramaean and Edomite composition of Israel involves a consideration of the territories occupied in early times by the tribes and their progenitor (Deut. xxvi, 5). Abel and Dan were considered as definitely Israelite cities (see *The Cambridge Ancient History,* 1926, vol. ii, pp. 368–69).

**ABEL TEST,** the close-test process of determining the flash-point of petroleum, invented by Sir Frederick Abel and embodied in the British Petroleum Act of 1879. The test is employed to ascertain whether a sample of petroleum may be safely used at a given temperature.

The Abel apparatus simply raises the temperature of the sample under test until the resultant combination of oil vapour and air forms an explosive mixture and causes a flash. The minimum limit of flash-point under British law is 73°, and most civilized countries have provided a similar test of inflammability. (*See* PETROLEUM.)

**ABENCERRAGES,** a family or faction that is said to have held a prominent position in the Moorish kingdom of Granada in the 15th century. The name appears to have been derived from Yussuf-ben-Serragh, the head of the tribe in the time of Mohammed VII. It is familiar from the interesting romance of Ginés Perez de Hita, *Guerras civiles de Granada,* which celebrates the feuds of the Abencerrages and the rival family of the Zegris. The hall of the Abencerrages in the Alhambra takes its name from being the reputed scene of the massacre of the family.

**ABENDANA,** the name of two Jewish theologians. (1) JACOB (1630–95), rabbi (Hakham) of the Spanish Jews in London from 1680. (2) ISAAC (*c.* 1650–1710), his brother, teacher of Hebrew at Cambridge and afterwards at Oxford. He compiled a Jewish calendar and wrote *Discourses on the Ecclesiastical and Civil Policy of the Jews* (1706).

**ABENEZRA** (Ibn Ezra), whose full name was Abraham ben Meir Ibn Ezra (1092 or 1093–1167), Jewish poet and scholar, was a native of Toledo. He had already gained a reputation as a thinker and poet before he left Spain, some time before 1140, and began the travels in northern Africa, in England, France and Italy which extended over a quarter of a century. He translated the writings of Hayyūj, the father of modern Hebrew grammar, from Arabic into Hebrew, and himself wrote treatises on the subject, the most important of which are *Moznayim* ("the Scales"), written in 1140, and *Zahot* ("Correctness"), written in 1141. His writings include works on philosophy, astronomy and mathematics; but his fame is derived chiefly from his commentaries on the Scriptures. Ibn Ezra sought to establish the simple sense of the text, basing his interpretation on solid grammatical principles. The commentary on the Pentateuch was first printed at Naples in 1488; in this edition a second commentary on Exodus takes the place of the original one. The great editions of the Hebrew Bible contain other commentaries by Ibn Ezra on Isaiah, the Minor Prophets, Job and Daniel; and his name was attached to commentaries on Proverbs, Ezra and Nehemiah, which were really the work of Moses Kimhi.

The *Yōsōd Mēra* (1158), the best known of his writings on the philosophy of religion, explains the reasons for the biblical commandments.

BIBLIOGRAPHY.—Among the literature on Ibn Ezra may be especially mentioned: M. Friedländer, *Essays on the Writings of Ibn Ezra* (London, 1877); W. Bacher, *Abraham Ibn Ezra als Grammatiker* (Strasburg, 1882); M. Steinschneider, *Abraham Ibn Ezra,* in the *Zeitschrift fur Mathematik und Physik,* Band xxv. Supplement; D. Rosin. *Die Religionsphilosophie Abraham Ibn Ezra's* in vols. xlii and xliii of the *Monatschrift fur Geschichte und Wissenschaft des Judenthums;* his *Divan* was edited by T. Egers (Berlin, 1886), a collection of his poems, *Reime und Gedichte,* with translation and commentary, were published by D. Rosin in several annual reports of the Jewish theological seminary at Breslau (1885–94).

**ABENSBERG,** a town and spa of Germany, in Bavaria, on the Abens, a tributary of the Danube, 18 mi. S.W. of Regensburg. Pop. (1933) 2,392. Some Roman remains exist in the neighbourhood of the town, which was known to the Romans as Castra Abusina. Here Napoleon defeated the Austrians under the Archduke Louis and Gen. Hiller on April 20, 1809

**ABEOKUTA,** a town of British West Africa, the capital of the Egba division of the Yoruba people and of the province of Abeokuta, southern Nigeria. It is situated in 7° 8′ N., 3° 25′ E., on the Ogun river, 64 mi. north of Lagos by railway or 81 mi. by water. Population (1938 census) 69,502. Abeokuta is surrounded by mud walls 18 mi. in extent and lies in a beautiful and fertile country, the surface of which is broken by masses of gray granite. Besides the usual mud-built houses there are several buildings (including public offices) of modern design. Palm-oil, timber, yams and shea-butter are the chief articles of trade.

Abeokuta (a word meaning "under the rocks"), dating from 1825, owes its origin to incessant inroads of slave-hunters from Dahomey and Ibadan, which compelled the village populations to take refuge in this rocky stronghold, which became the capital of the Egba state, the ruling chief being styled *Alake* (Ake is the principal quarter of Abeokuta and is the name of the ancient Egba capital). The Egba carried on a long war with Ibadan and claimed the right to close the trade routes to Lagos. This brought them from 1865 onward into collision with the British, but in 1893 a treaty was signed which, while preserving Egba independence in internal affairs, brought the state under direct British influence. Christian missions had been in Abeokuta since 1843 and gained many converts; in 1867 the Christians were expelled. They returned some years later and now form an influential part of the population. The town is the headquarters of the Yoruba branch of the Church Missionary society.

After 1899 when the railway from Lagos reached Abeokuta there was a large increase in trade. Meanwhile the Egbas had set up a government based on European models, and in 1904 the *Alake* created some interest in his country by a visit to England. But side by side with an administration on modern lines (including fiscal barriers) "there existed," to quote Sir F. D. Lugard, "the ancient *régime* with all its abuses—extortionate demands from the peasantry, corruption and bribery in the courts, arbitrary imprisonment and forced labour." These conditions could not be tolerated and in 1914 by a new agreement the Egbas renounced "independence," and their country, with Jebu and other districts, was constituted the province of Abeokuta. Since then the *Alake* and his council have carried on the native administration under the supervision of a British resident. In 1917 a somewhat serious rising occurred in the province; it was the only instance of the peace being disturbed in Nigeria during World War I.

*See* Sir F. D. Lugard's *Report on Nigeria* (pub. in 1920) as a White Paper (cmd. 468); an article on Abeokuta by Sir Wm. Macgregor, *African Society's Journal* No. xii (July, 1904); and Sir W. N. Geary, *Nigeria under British Rule* (1927).

**ABERAVON:** *see* PORT TALBOT.

**ABERCARN,** urban district, Monmouthshire, England. Pop. (est. 1938) 18,510. Area, 14.91 sq.mi. It is situated in the middle portion of the Ebbw valley and like the other towns of the north and east of the coal field had an early association with iron smelting and then relied more and more on the export of coal, but tin plates are manufactured in large quantities. Like the other towns of the coal field, it is mainly a long street along the valley. It shared the deep industrial depression in the neighbourhood in the 1930s. Abercarn has a station on the Great Western railway branch line from Newport and is in the Abertillery parliamentary division.

**ABERCORN, JAMES HAMILTON,** 1ST EARL OF (*c.* 1575–1618), was the eldest son of Claud Hamilton, Lord Paisley (4th son of James, 2nd Earl of Arran, and Duke of Chatelherault), and of Margaret, daughter of George, 6th Lord Seton. He was made sheriff of Linlithgow in 1600, received large grants of lands in Scotland and Ireland, was created in 1603 Baron of Abercorn and on July 10, 1606, was rewarded for his services in the matter of the union by being made Earl of Abercorn and Baron Hamilton, Mount Castle and Kilpatrick. He married Marion, daughter of Thomas, 5th Lord Boyd, and left five sons, of whom the eldest, Baron of Strabane, succeeded him as 2nd Earl of Abercorn. He died on March 23, 1618. The title of Abercorn, held by the head of the Hamilton family, became a marquisate in 1790 and a dukedom in 1868.

ABERCORN, JAMES HAMILTON, 2ND DUKE OF (1838–1913) British politician, born on Aug. 24, 1838, succeeded his father, the 1st Duke, in 1885. His sister, the Duchess of Buccleuch, was for many years mistress of the robes to Queen Victoria and to Queen Alexandra. The duke became a member of the household of the Prince of Wales (afterwards Edward VII.). He was a strong supporter of the Unionist Party in the House of Lords, and was chairman of the British South Africa Company. He died in London on Jan. 3, 1913.

ABERCORN, JAMES ALBERT EDWARD HAMILTON, 3RD DUKE OF (1869– ), British politician, son of the preceding, was born on Nov. 1, 1869, and was educated at Eton. Lord James Hamilton was M.P. for Londonderry, 1900–13, a leader of the Unionist Party in Ulster, and treasurer of H.M. Household in 1903–05. After the passage of the Government of Ireland Act, he became a senator of Northern Ireland, and in 1922 was appointed governor.

ABERCROMBIE, LASCELLES (1881–1938), English poet, was born at Ashton-under-Lyne, Cheshire, Jan. 9, 1881, and educated at Malvern and Victoria university, Manchester, where he studied science. His first work, *Interludes and Poems*, appeared in 1908. Other works are: *Mary and the Bramble* (1910); *Emblems of Love* (1912); *Deborah* (1912); *Speculative Dialogues* (1913); and *Collected Poems* (Oxford Poets, 1930). He was lecturer in poetry, Liverpool university, 1919–22; professor of English literature at Leeds university, 1922–29, and at London university 1929–35; and Goldsmith Reader in English at Oxford, 1935–38. To his students he emphasized the essential greatness of the writers he dealt with, rather than cumbersome details. His critical study of *Thomas Hardy* (1912), the *Theory of Poetry* (1924), his volume of collected lectures, *The Idea of Great Poetry* (1925), and *Liberty of Interpreting* (1930), and *Poetry—Its Music and Meaning* (1932), are important contributions to modern critical literature. His works include some plays in blank verse, among them *Phoenix* (1923).

**ABERCROMBY, DAVID,** a 17th century Scottish physician. His *Nova medicinae praxis* was reprinted after his death in Paris (1740). His *Tuta ac efficax luis venereae saepe absque mercurio ac semper absque salivatione mercuriali curando methodus* (1684) was translated into French, Dutch and German. In his *Discourse on Wit* (1685) he expounds the Scottish philosophy of common sense. The exact date of his death is unknown, but according to Haller he was alive early in the 18th century.

**ABERCROMBY, PATRICK** (1656–*c.* 1716), Scottish physician and author, was born at Forfar, and educated at St. Andrews. He is best known as the author of the *Martial Atchievements of the Scots Nation* (fol. 1711–16), in which he had the assistance of many learned contemporaries. As a pamphleteer on behalf of the Union he crossed swords with Daniel Defoe.

**ABERCROMBY, SIR RALPH** (1734–1801), British soldier, eldest son of George Abercromby, of Tullibody, Clackmannanshire, was born Oct. 7, 1734. Educated at Rugby and at Edinburgh University, he was sent in 1754 to Leipzig to study civil law, with a view to his proceeding to the Scottish bar. But he received a commission in the 3rd Dragoon Guards in March 1756. He served with his regiment in the Seven Years' War, and study of the methods of the great Frederick moulded his military character and formed his tactical ideas. In 1781 he became colonel of the King's Irish infantry. When that regiment was disbanded in 1783, he retired upon half pay. Hitherto he had scarcely been engaged in active service, mainly because of his disapproval of the policy of the Government, and especially because of his sympathies with the American colonists in their struggles for independence; and his retirement was no doubt the result of similar feelings. But on the declaration of war by France against England in 1793, he returned to the Army, and was appointed to the command of a brigade under the Duke of York, for service in Holland. He commanded the advanced guard in the action at Le Cateau, and was wounded at Nijmwegen. The duty fell to him of protecting the British Army in its disastrous retreat out of Holland in the winter of 1794–95. In 1795 he received a knighthood of the Bath, and in the same year he was appointed to succeed Sir Charles Grey as commander-in-chief of the British forces in the West Indies. In 1796 he seized Grenada, and then took the settlements of Demerara and Essequibo, and the islands of St Lucia, St Vincent and Trinidad. He held, in 1797–98, the chief command of the forces in Ireland. He sought to restore the discipline of the army, and declined to allow the military to be called out, except when it was indispensable for the maintenance of order. Finding that all his efforts were thwarted by the Government in Ireland, he resigned the command. After acting as commander-in-chief in Scotland, Sir Ralph was second-in-command to the Duke of York in the second disastrous expedition to Holland in 1797. In 1801 he was sent with an Army to turn the French out of Egypt. The disembarkation on March 2 of the troops at Aboukir Bay, in the face of strenuous opposition, is justly ranked among the most daring and brilliant exploits of the British Army. The French made a surprise attack on the British camp near Alexandria (March 21, 1801), and Abercromby fell in the moment of victory. He was struck by a spent ball, which could not be extracted, and died on board the flagship seven days after the battle. By a vote of the House of Commons, a monument was erected in his honour in St Paul's Cathedral. His widow was created Baroness Abercromby of Tullibody and Aboukir Bay, and a pension of £2,000 a year was settled on her and her two successors in the title.

A memoir of the later years of his life (1793–1801) by his third son, James (who was Speaker of the House of Commons, 1835–39, and became Lord Dunfermline), was published in 1861. For a shorter account of Sir Ralph Abercromby . . . . . *Twelve British Soldiers* (London, 1899).

**ABERDARE, HENRY AUSTIN BRUCE, 1ST BARON** (1815–95), English statesman, was born at Duffryn, Aberdare, Glamorganshire, on April 16, 1815. He was called to the bar in 1837, and was stipendiary magistrate for Merthyr Tydvil and Aberdare, 1847–52. The discovery of coal in the Duffryn and Aberdare estates of the family made him a rich man. He sat in the House of Commons for Merthyr Tydvil from 1852–68 and for Renfrewshire from 1869–73, when he became a peer. He was under-secretary at the Home Office (1862–64), vice-president of the board of education (1864–66), home secretary (1868–73), and lord president of the council (1873–74). After the defeat of the Liberal Government in 1874 Lord Aberdare turned to social and economic questions. From 1882, when he became chairman of the National African Company incorporated under charter in 1886 as the Royal Niger Company, he was closely associated with West African affairs. He presided over several royal commissions, and promoted university education in Wales. He died in London on Feb. 25, 1895.

**ABERDARE,** industrial town and urban district of Glamorganshire, Wales, at the confluence of the Dar and Cynon (the latter being a tributary of the Taff). Pop. (est. 1938) 43,030. Area, 25 sq.mi. The neighbouring moorlands show evidences of occupation in pre-Roman times, and a site about 4 mi. to the north-west of the town is reputed to be the scene of a Norman victory over the native forces under Rhys ap Tewdwr in the 11th century. Aberdare remained but a small nucleus among the scattered farms of the moorlands until the beginning of the 19th century when the place grew rapidly owing to the abundance of its coal and iron ore, and the population of the whole parish (which was only 1,486 in 1801) increased tenfold during the first half of the century. Ironworks were established at Llwydcoed and Abernant in 1799 and 1800 respectively, followed by others at Gadlys and Aberaman in 1827 and 1847. The building of the Glamorgan canal in 1811 connected these ironworks with the coast, but the rapid development of the railways superseded the canals and at the same time gave an impetus to the iron trade between 1820 and 1870 and a consequent rapid growth of the town. These ironworks have not been worked since 1875, and the only supplementary industry remaining in the town is a small tinplate works at Gadlys (established in 1868). Previous to 1836, most of the coal worked in the parish was consumed locally, chiefly in the ironworks, but in that year the working of steam coal for export was begun, pits were sunk in rapid succession, and the coal trade, which at

least since 1875 has been the chief support of the town, soon reached huge dimensions. There are several brickworks and breweries. This town was severely affected by the depression of the 1930s, 37.1% of the insured population being unemployed in May 1934. Until 1918 Aberdare was included for parliamentary representation with the borough of Merthyr Tydfil, but since then it returns a member jointly with the urban district of Mountain Ash.

**ABERDEEN, GEORGE GORDON, 1ST EARL OF** (1637–1720), lord chancellor of Scotland, was the son of Sir George Gordon of Haddo, who had been executed by the Presbyterians in 1664. He was born Oct. 3, 1637, and studied at Aberdeen and abroad. He was called to the bar in 1668 and gained a great reputation as a lawyer. He was president of the court of session in 1681 and lord chancellor of Scotland from 1682 to 1684. He was created earl of Aberdeen in 1682.

Burnet reflects unfavourably upon him, calls him "a proud and covetous man," and declares "the new chancellor exceeded all that had gone before him." He executed the laws enforcing religious conformity with severity, and filled the parish churches, but resisted the excessive measures of tyranny prescribed by the English government; and in consequence of an intrigue of the Duke of Queensberry and Lord Perth, who gained the duchess of Portsmouth with a present of £27,000, he was dismissed in 1684. He remained a non-juror during the whole of William's reign, and took the oaths for the first time after Anne's accession, on May 11, 1703. In the affair of the Union in 1707, he protested against the completion of the treaty till the act declaring the Scots aliens should be repealed, but refused to support the opposition to the measure itself. He died on April 20, 1720.

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**ABERDEEN, GEORGE GORDON,** 4TH EARL OF (1784–1860), British statesman, was born in Edinburgh on Jan. 28, 1784, the son of George Gordon, Lord Haddo. At the age of 11, when he was left an orphan, he went to reside with Henry Dundas, afterwards Lord Melville; and three years later he was permitted by Scots law to select William Pitt and Dundas as his curators, or guardians. At Harrow and at St. John's college, Cambridge, he proved himself a gifted classical scholar, though modern history shared his interest; and his education was completed by an extended tour of Europe which took him to the Far East. On the death of his grandfather in 1801 he succeeded to the peerage, and four years later he married Catherine Hamilton, daughter of Lord Abercorn.

His connection with Pitt and Dundas, and his native ability, favoured him for a political career, and in 1812 he travelled as ambassador extraordinary to Austria, where he signed the Treaty of Töplitz in 1813. He remained on the Continent as one of the most active British representatives throughout the negotiations which led to the Treaty of Paris; then he returned to England, and for some years lived in comparative retirement. The year 1815 saw his marriage to Harriet, Lady Hamilton, his first wife having died three years before.

In Jan. 1828 he joined the cabinet of the duke of Wellington, and in the following June he became secretary of state for foreign affairs. Resigning in 1830 with Wellington, he did not again take office until the short administration of 1834 and 1835, when he was colonial secretary to Sir Robert Peel; but in 1841 he joined the latter's cabinet as foreign secretary and commenced the most fruitful and successful period of his public life. He now acquired more power than he had ever possessed with Wellington, to whom he had felt himself subordinate; and this new authority he devoted first to establishing friendly relations with France. Public opinion in both countries exhibited hostility, so that the marriage of Isabella II. of Spain and the imprisonment of Pritchard in Tahiti might have led to a quarrel; but Aberdeen was fortunate in having the confidence of Guizot, and it was largely through their efforts that a satisfactory understanding was maintained. He was equally successful in avoiding a rupture with the United States, which might easily have resulted from the question involving the boundary between that country and Canada. The north-east frontier was first settled amicably by the Webster-Ashburton Treaty of 1842, but in 1844 the new democratic administration in the States claimed from Britain the whole of the Pacific coast as far as Russian Alaska. To this demand Peel's Government refused to yield, and Aberdeen crowned his successful term at the Foreign Office with the Oregon Treaty of 1846, which fixed the boundary along the forty-ninth degree of latitude.

In 1845 he supported Peel in a proposal to suspend the duty on foreign corn, and left office with him in July 1846. After Peel's death in 1850, Aberdeen was recognized as leader of the Peelites, and in 1852, at the head of a coalition ministry of his own party and the Whigs, he became first lord of the Treasury. Although united on free trade and on questions of domestic reform generally, a cabinet including Lord Palmerston and Lord John Russell, in addition to Aberdeen, was certain to differ on foreign policy; and contemporaries realized that the task of the prime minister was one of unusual difficulty. "In the present cabinet," wrote Charles Greville, in his *Memoirs,* "are five or six men of equal or nearly equal, pretensions . . every one of these five or six considering himself abler and more important than their premier." Nevertheless, the first year of this administration was successful, and it was due to Aberdeen's steady support that Gladstone's great budget of 1853 was accepted by the cabinet; but the weakness of Aberdeen and of the cabinet soon became apparent in the negotiations which preceded the Crimean War. That the prime minister wished to maintain the peace is unquestionable, but whether he acted wisely to this end is more obscure. His foreign policy was essentially one of peace and non-intervention; but his character is perhaps best described by a writer who says "his strength was not equal to his goodness."

The Vienna note, by which the four powers sought to find terms which were agreeable to both Russia and Turkey, was largely the result of Aberdeen's endeavours; and when Turkey refused to accept the proposed agreement, Aberdeen would not have offered her British support had not the publication of a secret Russian document in Berlin thrown doubt upon the Tsar's intentions. Even then he sought to preserve the peace by presenting a new note early in Dec. 1853 to the two countries; but when he wished to insist upon Turkey's acceptance of these terms, Lord John Russell refused to support him. Rather than risk a break up of the cabinet, Aberdeen consented to a compromise of which advantage was taken by those who desired war; and Turkey was thus enabled to force England with her into the disastrous struggle. The stories of misery and mismanagement from the seat of war deprived the Government of public favour. Russell resigned; and in Jan. 1855, he was followed by Aberdeen, who interpreted a motion by J. A. Roebuck as one of no confidence. He died in London, on Dec. 14th, 1860, and was buried in the family vault at Stanmore. He left four children by his second wife, who died in Aug. 1833; the eldest son, George John James, succeeded as 5th earl; his youngest son, Arthur Hamilton, was created Baron Stanmore in 1893. Aberdeen wrote *An Inquiry into the Principles of Beauty in Grecian Architecture,* which was published in London, 1822. A bust of him by Matthew Noble is in Westminster Abbey, and his portrait was painted by Sir T. Lawrence.

*See* Sir T. Martin, *Life of the Prince Consort* (1875–80); A. W. Kinglake, *Invasion of the Crimea* (1877–88); Spencer Walpole, *History of England* (1878–86), C. C. F. Greville, *Memoirs,* edited by H. Reeve (1888); Spencer Walpole, *Life of Lord John Russell* (1889); Lord Stanmore, *The Earl of Aberdeen* (1893); J. Morley, *Life of Gladstone* (1903).

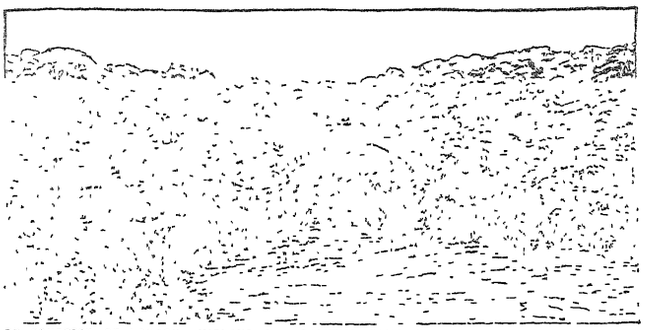
**ABERDEEN,** a royal and parliamentary burgh, city and county of a city, the capital of Aberdeenshire and chief seaport in the north of Scotland. Pop. (est. 1938) 178,199. It is the fourth Scottish town in population, industry and wealth, and stands on a bay of the North Sea between the mouths of Don and Dee, 130½ mi. N.E. of Edinburgh by the L.N.E.R. Though the residential suburb of Old Aberdeen, extending from the city suburbs to the southern banks of the Don, has a separate charter, history and

parliament there is no distinction between it and New Aberdeen for parliamentary, municipal or other purposes Aberdeen derives its popular name of the "Granite City" from its building stone, which under sunshine after rain gleams white and justifies the town's more poetical designation of the "Silver City by the Sea" The land area of the city is 17 22 sq mi. The burghs of Old Aberdeen and Woodside, and the district of Torry, to the south of the Dee, were incorporated in 1895. After 1928 the city comprised 12 wards and 21 ecclesiastical parishes. It is under the jurisdiction of a council with lord provost, bailies, treasurer and dean of guild. The corporation prior to World War II began to give a good deal of attention to improving the town as a holiday resort.

**Streets and Buildings.**—Roughly, the extended city runs north and south. From the new bridge of Don to the "auld brig" of Dee there is tramway communication via King street, Union street and Holburn road—a distance of over five miles. The name of the ancient castle of Aberdeen, long since demolished, is preserved in Castle street, Castlegate and Castlehill. From Castle street the imposing Union street 70 ft. wide runs west-south-west for nearly a mile, and contains the principal shops and most of the modern public buildings, all of granite. Part of the street crosses the Denburn ravine by a fine granite arch of 132ft. span, portions of the older town fringe the gorge, 50 ft. below the level of Union street. The Trinity Hall of the incorporated trades, originating between 1398 and 1527, and having charitable funds, contains some fine portraits attributed to George Jamesone, who was a native of Aberdeen and one of the earlier British portrait painters. Castle street continues Union street eastwards, and has the fine structures of the municipal and county buildings in Franco-Scottish Gothic (1867–78), the sheriff court house and the town hall, with excellent portraits; from the south-west corner a tower commands a fine view. At the upper end of Castle street stands the Salvation Army Citadel, one of the most imposing "barracks" possessed by this organization. In front of it is the beautiful Market Cross, one of the most notable of its kind in Scotland, an open-arched, hexagonal structure, 21ft. in diameter and 18ft. high, dating originally from 1682, when it replaced an earlier cross, and rebuilt on its present site in 1842. On an eminence east of Castle street are the military barracks, Aberdeen being the depot of supplies for the Gordon Highlanders. The fish market on the Albert Basin is an important centre of activity. The art gallery and museum is at Schoolhill, the Macdonald Hall containing portraits of contemporary artists by themselves being unique of its kind in Great Britain. In Sept. 1925 the city's war memorial was opened; it consists of a domed court, or hall of remembrance, attached to the art gallery and museum. Other extensions, enlarging the facilities of the art gallery and museum, opened at the same time include Cowdray Hall, used for lectures, with the Cowdray Museum of Applied Arts beneath it.

The see of Aberdeen is represented by the Old Cathedral of St. Machar, the only granite cathedral in the British Isles; the beginnings of the present structure date from the 14th century and were completed by Bishops Elphinstone (1484–1511) and Gavin Dunbar (1520). On the flat panelled ceiling are the heraldic shields of princes, noblemen and bishops who shared in its erection. The name of St. Machar (or Mochonna) is referred by tradition to a disciple of St. Columba who founded a chapel here for the conversion of the Picts. The bishopric, traditionally founded at Mortlach (Banffshire) by King Malcolm II. in 1010, in honour of a victory over the Danes, was transferred to Aberdeen by King David I. about the year 1137, a bull of Pope Adrian IV. dated 1157 "confirming all grants made by the kings of the Scots." "The church of Aberdeen" which is mentioned in the same bull, together with the church of St. Machar, is held to refer to the old church of St. Nicholas, of which there remains the Drum and Collison aisles which now link the east and west churches and an eastern crypt. The John Knox parish church was rebuilt in 1911; the Roman Catholic cathedral (Gothic, 1859) is in Huntly street. The episcopal cathedral of St. Andrews is the mother church of the Protestant Episcopal Church in the United States

The Dee is crossed by four bridges, including the railway bridge Till 1832 the old bridge of Dee built by Bishops Elphinstone and Dunbar (and rebuilt in 1718–23 and 1842) formed the only entry to the city from the south The bridge of Don, consisting of five granite arches, was built in 1827–32 The Auld Brig o' Balgownie, said to have been built by Robert the Bruce in the 13th century and celebrated by Byron in the tenth canto of *Don Juan,* is one of the oldest historical bridges still in use The parks and open



BY COURTESY OF LONDON, MIDLAND AND SCOTTISH RAILWAY

THE "AULD BRIG O' BALGOWNIE" AT ABERDEEN, SUPPOSEDLY BUILT BY ROBERT THE BRUCE (1274–1329), AND CELEBRATED IN BYRON'S POEM, "DON JUAN"

spaces include Duthie Park (45 acres), the gift of Miss Elizabeth Crombie Duthie of Ruthrieston; Victoria Park (13 acres) and its extension Westburn Park (13 acres); Stewart Park (11 acres), after Sir D. Stewart, lord provost in 1893; and Hazelhead Park. Capacious golf links and a bathing beach border the sea.

**Education.**—Aberdeen university consists of King's college in Old Aberdeen, founded by Bishop Elphinstone (*q.v.*) in 1494, and Marischal college, in Broad street, founded in 1593 by George Keith, 5th earl Marischal, the two colleges being incorporated together, 1860. In all 34 chairs, 3 readerships and 68 lectureships had been founded by 1943 Handsome new buildings have been erected. Important additions to the resources of the university are the Rowett institute for research in animal nutrition and the Macaulay institute for soil research. Donations have been received for scholarships and bursaries, and the Carnegie Trust has made grants for the erection of buildings.

King's forms a quadrangle with interior court; the Crown Tower and the Chapel, the oldest parts, date from 1500. The choir of the chapel contains the original oak canopied stalls, miserere seats and lofty open screens in French flamboyant style. The principal at the time of the Reformation armed his folk to save the building from the barons of the Mearns (the modern Kincardineshire) after they had robbed St. Machar's of its bells and lead. The building of Marischal college was erected in 1836–41 and has been greatly extended since. Dr. Charles Mitchell gave the great graduation hall and the Mitchell tower (233 ft.), opened in 1895, on the 400th anniversary of the university's foundation. A lintel stone from the old buildings of Marischal college is preserved at the foot of the Mitchell tower, bearing the famous inscription: THAY HAIF SAID · QUHAT SAY THAY LAT THAME SAY, the circumstances giving rise to which are believed to embody the founder's retort to criticisms passed against him for his appropriation (by gift from the Crown) of lands and revenues belonging to the suppressed Cistercian abbey of Deer. A botanic garden was presented to the university in 1899.

Aberdeen, St. Andrews, Edinburgh and Glasgow universities combine to return three members to Parliament. The United Free Church college is in Tudor Gothic (1850). The Grammar school, reputedly first heard of in 1256, was removed in 1861–63 from Schoolhill to new buildings off Skene street. Robert Gordon founded (1729) and Alexander Simpson further endowed (1816) Gordon's Hospital for instruction and maintenance of sons of poor burgesses of guild and trade; in 1881 it became Robert Gordon's college for secondary and technical education.

**Harbour.**—A formerly defective harbour with a bar has been greatly deepened under various Acts since 1773. The north pier,

built partly by John Smeaton in 1775–81 and partly by Thomas Telford in 1810–15, extends nearly 2,000 ft. into the North sea. It increases the depth of water on the bar from a few feet to 32 ft. at high water, and 19½ ft at low water, spring tides. The wet Victoria dock of 29 ac., and with 6,000 ft. of quay, was completed in 1848. Adjoining it is the upper dock. By the Harbour act of 1868, 90 ac. of new ground (in addition to 25 ac. formerly made up) were provided on the north side of the Dee for the Albert basin (with a graving dock), quays and warehouses. A breakwater of concrete, 1,050 ft. long, was constructed on the south side of the stream, and a third floating dock was built in 1911.

**Industry.**—Gray granite has long been quarried, and blocked and dressed paving "setts," curb and building stones and monumental work exported. Aberdeen is an important centre of the Scottish fisheries, the antiquity of which is shown by the mention of the provision of "dried fish from Aberdeen" in the royal wardrobe accounts of the 13th century. Other industries include jute, paper, agricultural materials, sail, rope and timber manufactures, engineering, chemical works, soap and candles and distilling. In the days of wooden ships shipbuilding flourished, the town being noted for its fast clippers, many of which established records in the "tea races." The introduction of trawling revived this to some extent, and there are large shipbuilding and repairing yards.

**History.**—Aberdeen was important as far back as the 12th century. Corporate rights were granted by a royal charter of King William the Lion (1179), from whose times down to the 14th century the Scottish kings maintained a royal residence in Aberdeen. The city received other royal charters later. After it was burned by the English king Edward III in 1336, the new town which was built was called New Aberdeen to distinguish it from Old Aberdeen The burgh records are the oldest in Scotland, being complete with one brief break from 1398 to the present day. During the struggles between the royalists and the Covenanters the city was plundered by both. In the Scottish wars of independence led by William Wallace and Robert Bruce, Aberdeen gave its aid to both. The motto on the city arms of "Bon Accord" traditionally commemorates the watchword used by the Aberdonians aiding Robert Bruce. In 1715 the earl of Mar proclaimed the Old Pretender at Aberdeen.

Once strongly fortified, the gates of the city were all removed by 1770. The importance of Aberdeen as a royal burgh and trading port placed it from the earliest times in the first rank of Scottish towns, a position which its great cathedral and, later, the fame of its university both served to maintain.

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**ABERDEEN,** a city of northeastern Mississippi, U.S., on the Tombigbee river; the county seat of Monroe county. It is on federal highway 45, and is served by the Frisco and the Illinois Central railways. There is a municipal airport. The population was 5,282 in 1950, 4,746 in 1940 and 3,925 in 1930 by the federal census. Industries include lumbering, a bentonite plant, garment plant, frozen food locker and cotton compress. Aberdeen was incorporated in 1837 and named by the founder, Robert Gordon, a Scotchman.

**ABERDEEN,** a city of South Dakota, U.S., the county seat of Brown county. It is in the northeastern part of the state, on federal highway 12, about 270 mi. W. by N. of Minneapolis, Minn., and is served by the Chicago, Milwaukee, St. Paul and Pacific, the Great Northern, the Chicago and North Western and the Minneapolis and St. Louis railroads. The population was 20,976 in 1950.

Aberdeen is the financial and trading centre of the northern part of the state, a fine agricultural region producing grain, potatoes, hay and flax. Retail sales in 1948 amounted to $38,862,000, ranking Aberdeen among the first 15 cities of the United States in retail sales volume per capita. Northern State Teachers college was established there in 1901. Largest teachers college in the state, it had an enrolment of approximately 700 at mid-20th century. It maintains a summer biological station at Enemy Swim lake near Waubay. Aberdeen was settled in 1880 and was chartered as a city in 1883.

**ABERDEEN,** a port of entry, the largest city of Grays Harbor county, Wash., U S., at the head of Grays Harbor, 49 mi. W. of Olympia. It has an area of 10.5 sq.mi.; is built on both sides of the Chehalis and the Wishkah rivers; and adjoins the city of Hoquiam (*q.v.*) on the west, and the town of Cosmopolis (population 1950, 1,161) on the east. The population of Aberdeen increased from 3,747 in 1900 to 18,846 in 1940 (about 20% foreign-born white, Scandinavians predominating) by the federal census and 19,475 in 1950. The three municipalities form one community, with a population of more than 31,000; served by the Northern Pacific, the Union Pacific and the Chicago, Milwaukee, St. Paul and Pacific railways, by autostages and by steamship lines to all world ports. Its products are plywood, pulp and paper, lumber, furniture, shingles, veneer, fish, fisheries by-products and cranberries.

Grays Harbor was discovered in 1792 by Capt. Robert Gray of Boston, on a trading voyage around the world. Aberdeen was founded in 1867 by Samuel Benn, who in 1873 established a cannery, and in 1883 planned the town site. It was incorporated in 1890.

**ABERDEEN AND TEMAIR, JOHN CAMPBELL GORDON,** 1ST MARQUESS OF (1847–1934), P.C., G.C.M.G., G.C.V.O., K.T., second son of the fifth earl of Aberdeen, was born in Edinburgh Aug. 3, 1847. He was educated at Oxford and succeeded his brother as sixth earl of Aberdeen in 1870, taking his seat in the house of lords early in 1873 and at once plunging into committee work. After being lord high commissioner to the general assembly of the Church of Scotland from 1881 to 1885—an office he again filled in 1915—William Ewart Gladstone appointed him lord lieutenant of Ireland in his short administration (Feb.–July) of 1886. Soon after the Liberals' next accession to power he became governor-general of Canada (1893) and after his return to England in 1898 took little part in politics. In Dec. 1905 he was again appointed lord lieutenant of Ireland; he held this office till May 1915, and in the following January received the title of marquess of Aberdeen and Temair (Tara). Both in Canada and in Ireland Lord Aberdeen's terms of office were distinguished by the cordial relationship which he maintained with the different peoples over whom he presided. He died March 7, 1934, and was succeeded by his son, the earl of Haddo (1879– ).

In 1877 Lord Aberdeen married the Hon. Ishbel Maria Majoribanks, a daughter of Lord Tweedmouth.

See *We Twa: Reminiscences of Lord and Lady Aberdeen* (1925).

**ABERDEEN PROVING GROUND** is located on the west side of the upper Chesapeake bay, U.S., covering about 75,000 ac. between Bush river and Swan creek in Maryland. A U.S. army installation under the jurisdiction of the ordnance department, it was originally acquired Oct. 16, 1917, and was made a permanent army post in Jan. 1919. Research and development of all ordnance items, including test activities and computations of firing tables and other technical data, are primary functions of the proving grounds. The ordnance school, ordnance department board, Aberdeen Ordnance depot and an air force base, Phillips field, are also located there. Some of the testing activities are performed at White Sands, N.M.

**ABERDEENSHIRE,** a northeastern county of Scotland, bounded north and east by the North sea, south by Kincardine, Angus and Perth and west by Inverness and Banff. It has a

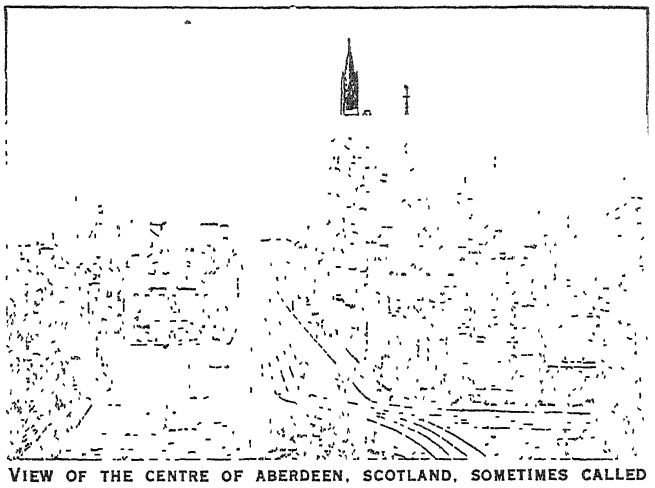
coast line of 65 mi.; and is the sixth Scottish county in land area, occupying 1,261 440 ac. or 1,971 sq.mi. The county is generally hilly, since from the south-west, near the centre of Scotland, the Grampians send out various branches in a general north-easterly direction. The county is watered by the rivers Dee, Don, Ythan, Ugie and Deveron—names, especially the two first, associated with some of the finest valley scenery on the eastward slope of Scotland. The upper valley of the Dee, about Braemar, penetrates the central mass of crystalline schists belonging to the metamorphic rocks of the eastern highlands, with extensive intrusions of later granites, which, on the border with Banffshire, rise in the fine mass of Ben Macdhui (4,296ft.) to a height second only to that of Ben Nevis among the mountains of the British Isles. This mountain commands views of one of the most beautiful parts of the central highlands, with the summits of Braeriach (4,248ft.), Cairntoul (4,241ft.) and Cairngorm (Banffshire) near by, the columnar cliffs of Corrie Etchachan, and Loch Avon in its deep gully, 2,500ft. above sea-level Among many other heights, "dark" Lochnagar, south-east of Braemar, is famed through a well-known song of Byron; and Benwachie, on the Banffshire border, through John Imlah's verse "O gin I were where Gadie rins." The shire is popularly divided into five districts Of these the first is Mar, mostly between Dee and Don, the southern half of the county with the city of Aberdeen. The soil on the Dee is sandy, and on the Don loamy. The second district, Formartine, between the lower Don and Ythan, has a sandy coast, succeeded inland by a clayey, fertile, cultivated tract, and then by low hills, moors, mosses and tilled land. Buchan, the third district, lies north of the Ythan, and comprises the north-east part of the county. The surface is bare, low, flat or gently undulating and in places peaty. The coast is in parts bold and rocky, and at the Bullers of Buchan, 6m. south of Peterhead, the sea enters a basin by a natural arch and boils up violently in stormy weather. Buchan Ness is the most easterly point of Scotland. The fourth district, Garioch, in the centre of the shire, is beautiful, undulating, loamy and fertile. Strathbogie, the fifth district south of the Deveron, mostly consists of hills, moors and mosses.

**Geology.**—The schists extend east from the central mass to Formartine and Peterhead. East down Dee and Don and north across the plain of Buchan towards Rattray head and Fraserburgh there is a development of biotite gneiss, partly of sedimentary and perhaps partly of igneous origin. A belt of slate quarried for roofing purposes runs along the west border of the county from Turriff by Auchterless and the Foudland hills towards the Tap o'Noth near Gartly. The metamorphic rocks have been invaded in almost every part of the county by igneous materials, some before, and by far the larger series after the folding of the strata. There are chalybeate springs at Peterhead and Pannanich near Ballater. The later granites subsequent to the plication of the schists have a wide distribution on the Ben Macdhui and Ben Avon range, and on Lochnagar; they stretch east from Ballater by Tarland to Aberdeen and north to Bennachie. Isolated masses appear at Peterhead and at Strichen. The Aberdeen granites have been widely used for building and paving, and extensively quarried at Rubislaw, Peterhead, Kemnay and elsewhere. The glacial deposits in the county indicate an eastward movement off the high ground at the head of Dee and Don, while the mass spreading outwards from the Moray Firth invaded the low plateau of Buchan; but at a certain stage there was a marked defection northwards parallel with the coast, as proved by the deposit of red clay north of Aberdeen. At a later date the local glaciers laid down materials on top of the red clay. The rivers abound with salmon and trout. Loch Muick, the largest of the few lakes in the county, 1,310ft. above the sea, 2½m. long and ⅓ to ½m. broad, lies some 8½m. south-west of Ballater, and has Altnagiuthasach, a royal shooting-box, near its south-west end. Red deer (in Braemar), grouse, and partridges are plentiful.

The climate of the upper Dee and Don valleys has a reputation as the driest and most bracing in the British isles, and grain is cultivable up to 1,600ft. above sea-level—considerably higher than elsewhere in the north of Great Britain. At Loch Muick vegetables, currants, laurels and roses flourish; the larch grows well, and elsewhere in Braemar natural timber, especially Scots fir in addition to larch, is particularly fine. Ash-trees, 5ft. in girth, are found at 1,300ft. elevation.

**History.**—The country now forming the shires of Aberdeen and Banff was originally peopled by northern Picts, whom Ptolemy called Taixali. Evidence of effective Roman occupation is lacking, though so-called Roman camps have been discovered on the upper Ythan and Deveron. Traces of the native inhabitants, however, are numerous. Weems or earth-houses are fairly common in the west. Relics of crannogs or lake-dwellings exist at Loch Ceander, or Kinnord, 5m. N E of Ballater, at Loch Goul in the parish of New Machar, and elsewhere. Duns or forts occur on hills at Dunecht, where the dun encloses an area of two acres, Barra near Old Meldrum, Tap o'Noth, Dunnideer near Insch and other places. Monoliths, standing stones and stone circles abound, and there are many early Christian sculptured stones. Efforts to convert the Picts were begun by Ternan in the 5th century and continued by Columba (who founded a monastery at Old Deer), Drostan, Maluog and Machar, but dissensions within the Columban Church and the expulsion of the clergy from Pictland by the Pictish king Nectan in the 8th century, undid most of the progress that had been made. The Vikings and Danes periodically raided the coast, but when (1040) Macbeth ascended the throne of Scotland the Northmen, under the guidance of Thorfinn, refrained from further trouble in the north-east. Macbeth was afterwards slain at Lumphanan (1057), a cairn on Perkhill marking the spot. Along with numerous Anglo-Saxon exiles after the Norman conquest of England there also came to Aberdeenshire Flemings who introduced various industries, Saxons who brought farming, and Scandinavians who taught nautical skill. The Celts revolted more than once, but Malcolm Canmore and his successors crushed them and confiscated their lands. In the 12th and 13th centuries some of the great Aberdeenshire families arose, including the earl of Mar (*c.* 1122), the Leslies, Freskins (ancestors of the dukes of Sutherland), Durwards, Bysets, Comyns and Cheynes, and in most cases their founders were immigrants. The Celtic thanes and their retainers slowly fused with the settlers. They declined to take advantage of the disturbed condition of the country during the wars of the Scots independence, and made common cause with the bulk of the nation. Though John Comyn (d. 1300?), one of the competitors for the throne, had considerable interests in the shire, his claim received locally little support. In 1296 Edward I. made a triumphal march to the north to terrorize the more turbulent nobles. Next year William Wallace surprised the English garrison in Aberdeen, but failed to capture the castle. In 1303 Edward again visited the county, halting at the castle of Kildrummy, then in the possession of Robert Bruce, and made Aberdeen his headquarters during several months. After Robert Bruce's death (1329) there was intermittent anarchy in the shire. Aberdeen itself was burned by the English in 1336, and the resettlement of the districts of Buchan and Strathbogie occasioned constant quarrels on the part of the dispossessed. Moreover, the Crown embroiled itself by trying to subdue some of the Highland chieftains. This policy culminated in the invasion of Aberdeenshire by Donald, lord of the Isles, who was, however, defeated at Harlaw, near Inverurie, by the earl of Mar in 1411. In the 15th century Sir Alexander Forbes was created Lord Forbes (*c.* 1442), and Sir Alexander Seton Lord Gordon in 1437 and earl of Huntly in 1445. Bitter feuds raged between these families but the Gordons' domains, already vast, were enhanced by the acquisition, through marriage, of the earldom of Sutherland (1514). Meanwhile commerce with the Low Countries, Poland and the Baltic had grown apace, Campvere, near Flushing in Holland, becoming the emporium of the Scottish traders, while education was fostered by the foundation of King's college at Aberdeen in 1494 (Marischal college followed a century later). At the Reformation so little intuition had the clergy of the drift of opinion that at the very time that religious structures were being despoiled in the south, the building

and decoration of churches went on in the shire. The change was acquiesced in without much tumult, though rioting took place in Aberdeen and St. Machar's cathedral in the city suffered damage. The 4th earl of Huntly offered some resistance, on behalf of the Catholics, to the influence of Lord James Stuart, afterwards the regent, Moray, but was defeated and killed at Corrichie on the Hill of Fare in 1562. As years passed it was apparent that Presbyterianism was less generally acceptable than episcopacy, of which system Aberdeenshire remained for generations the stronghold in Scotland. In 1638 the National Covenant was ordered to be subscribed, a demand so grudgingly responded to that the earl of Montrose visited the shire in the following year to enforce acceptance. The Cavaliers, not being disposed to



VIEW OF THE CENTRE OF ABERDEEN, SCOTLAND, SOMETIMES CALLED "THE GRANITE CITY," THE CHIEF CITY OF ABERDEENSHIRE

yield, dispersed an armed gathering of Covenanters in the affair called the Trot of Turriff (1639), in which the first blood of the Civil War was shed. The Covenanters obtained the upper hand in a few weeks, when Montrose appeared at the bridge of Dee and compelled the surrender of Aberdeen, which had no choice but to cast in its lot with the victors. Montrose, however, soon changed sides, and defeated the Covenanters under Lord Balfour of Burleigh (1644), and again after a stiff fight on July 2, 1645, at Alford. Peace was temporarily restored on the "engagement" of the Scots commissioners to assist Charles I. On his return from Holland in 1650 Charles II was welcomed in Aberdeen, but in little more than a year General Monk entered the city at the head of the Cromwellian regiments. The English garrison remained till 1659, and next year the Restoration was effusively hailed, and prelacy was again in the ascendant. After the Revolution (1688) episcopacy passed under a cloud, and as George I was antipathetic to the clergy, it happened that Jacobitism and episcopalianism came to be regarded in the shire as identical. The earl of Mar raised the standard of revolt in Braemar (Sept. 6, 1715); a fortnight later James was proclaimed at Aberdeen cross; the Pretender landed at Peterhead on Dec. 22, and in Feb. 1716 he was back again in France. The collapse of the first rising ruined many of the lairds, and when the second rebellion occurred 30 years afterwards the county in the main was apathetic, though the insurgents held Aberdeen for five months, and Lord Lewis Gordon won a trifling victory for Prince Charles Edward at Inverurie (Dec. 23, 1745).

**Population and Government.**—The population in 1938 was estimated at 325,231. In 1931, only 777 spoke Gaelic, all of whom spoke English also. As late as 1830 Gaelic was the common tongue almost throughout Braemar at least. The chief towns, with populations (est. 1938), are the large burgh of Aberdeen (178,199), and Peterhead (13,056), Fraserburgh (10,388), Huntly (3,985), Inverurie (4,728), and Turriff (2,562) of the ten small burghs. Aberdeen, Kintore and Inverurie are royal burghs. The supreme court of justiciary sits in Aberdeen to try cases from the counties of Aberdeen, Banff and Kincardine. The three counties are under a sheriff, and there are three sheriffs-substitute resident in Aberdeen, who sit also at Fraserburgh, Huntly and Peterhead The county, with Kincardineshire, sends three members to parliament. The county town, Aberdeen, returns two members.

**Agriculture.**—Except in favoured tracts, as in Formartine and Garioch, the glacial drift soils are generally poor, gravelly or peaty; but in no part of Scotland has careful cultivation more successfully increased productivity. About two-thirds of the population depend on agriculture. Farms are small compared with those in the southeastern counties. Of the 9,889 holdings in 1938 almost half were between 5 and 50 ac. Oats are the predominant crop (172,055 ac. in 1938), wheat has practically gone out of cultivation (188 ac.), but turnips and swedes (73,698 ac.) and barley (11,669 ac.) are grown. The county is by far the greatest for oat growing in Scotland and is second only to East Lothian for barley. Great numbers (185,277 in 1938) of the home-bred crosses of cattle are fattened for London and local markets, and Irish animals are imported on an extensive scale for the same purpose.

**Fisheries.**—The white and herring fishery is the next most important industry to agriculture, its development having been due almost exclusively to the introduction of steam trawlers Aberdeen is the chief Scottish centre for trawling and great line fishing, and the chief port for white fish. Fraserburgh is one of the largest centres of the North sea herring fishing. Haddocks are salted and rock-dried (speldings) or smoked (finnans). The ports and creeks are divided between the fishery districts of Peterhead, Fraserburgh and Aberdeen, the last of which includes also three Kincardineshire ports. The herring season for Aberdeen, Peterhead and Fraserburgh is from June to September, at which time the ports are crowded with boats from other Scottish districts. There are valuable salmon-fishings—rod, net and stake-net—on Dee, Don, Ythan and Ugie.

**Communications.**—From the south Aberdeen city is approached by the L.M.S.R. (via Perth, Forfar and Stonehaven), and the L.N.E.R. (via Dundee, Montrose and Stonehaven). A line of the latter company runs via Kintore and Huntly to Keith and Elgin. Branch lines from Aberdeen to Ballater by Deeside, from Aberdeen to Fraserburgh (with a branch at Maud for Peterhead and at Ellon for Cruden bay and Boddam), from Kintore to Alford, and from Inverurie to Old Meldrum and also to Macduff. By sea there is regular communication with London, Leith, Newcastle and Hull, Inverness, Wick and other ports, the Orkneys and Shetlands, and the Continent. The highest macadamized road crossing the East Grampians rises to a point 2,200 ft. above sea level.

**ABERDOUR,** village and civil parish, Fifeshire, Scotland. Pop. (1931), 2,055. On the shore of the Firth of Forth, 17½ mi. N.W. of Edinburgh by the L.N.E.R., 7 mi. N.W. of Leith by steamer, it is a favoured bathing resort. There are ruins of a castle and a church with fine Norman work. About 3 mi. S.W. is Donibristle House, the seat of the earl of Murray (Moray). The island of Inchcolm, or island of Columba, ¼ mi. from shore, is in the parish. Remains of 13th-century fresco have been found.

**ABERDOVEY** (ăb-ur-dŭv'ĭ) (ABERDYFI), a village on the north side of the Dyfi Estuary, Merionethshire, Wales. Population (1931) 1,203. Its site has associations in Welsh folklore with coastal submergence (*see* CARDIGANSHIRE). During the 17th, 18th and 19th centuries it had a considerable coasting and fishing trade, the export of slates from Corris and Aberllefenni being considerable. Aberdovey also exported lead ore from the mines of the Dyfi region. With the development of private motor traffic on a large scale after 1918 Aberdovey became increasingly a resort for visitors from the large towns of England.

**ABERFOYLE,** village and civil parish, Perthshire, Scotland, 34¼ mi. N.W. of Glasgow by the L.N.E.R. Population (1931) 1,014. The village is at the base of Craigmore (1,271 ft. high) and on the Laggan, a headwater of the Forth In 1885 the duke of Montrose built a road over the east shoulder of Craigmore to the Trossachs but this does not take motor traffic. The Laggan drains the small lochs Ard and Chon, the first of which is the scene of incidents in Scott's *Rob Roy*. There are slate quarries on Craigmore.

**ABERGAVENNY** (ăb ur-gĕn'ĭ or ăb-ur-gă-vĕn'ĭ), municipal borough, Monmouthshire, England, at the converge of roads from Crickhowell, Ross, Hereford, Newport and Merthyr, at the confluence of the Gavenny with the Usk Population (1938) 7,925. Area, 3 75 sq mi. There are evidences of the early occupation of the area on the hills around and the focus which became Abergavenny was the Roman Gobannium, a small fort guarding the road up the Usk. The town grew under the protection of the Norman lords of Abergavenny and there are remains of a castle built by Hamelin de Ballon in the 11th century. The mediaeval walled town contained a Benedictine monastery which later became the church of St. Mary, which contains many interesting monuments. Owing to its situation, the town was frequently embroiled in the border warfare of the 12th and 13th centuries and was burned by Owen Glendower (*q.v.*) in 1404 At the dissolution of the priory part of its endowment went towards a free grammar school. In 1639 Abergavenny received a charter of incorporation with bailiff and burgesses. Like most towns of similar history it showed strong conservative tendencies during the Civil Wars when the town suffered badly at the hands of Fairfax (1646), and again in 1688 when it lost its charter for its strong Jacobean demonstrations. The market was important as early as 1200 and further reference is made to it in 1657, but with the better roads and greater movement of the 18th and 19th centuries cattle and horse fairs became more important. In the 18th and early 19th centuries Abergavenny prospered as a market and social centre. It was also famous for its Welsh flannel Abergavenny was incorporated in 1899. Its boundaries were extended in 1935. It is in the parliamentary division of Monmouth.

**ABERIGH-MACKAY, GEORGE ROBERT** (1848–1881), Anglo-Indian writer, is known by his famous *Twenty-one Days in India* (1878–79), a satire upon Anglo-Indian society and ways of thinking.

**ABERNETHY, JOHN** (1680–1740), Irish Presbyterian divine, was born at Coleraine, county Londonderry, on Oct. 19 1680. He was educated at Glasgow, Edinburgh and Dublin, and was pastor of a church at Antrim for 14 years. In 1717 he was assigned by the synod to Usher's Quay, Dublin. He declined to obey, and remained at Antrim. This refusal became a test case of the authority of the ecclesiastical courts, and Irish Presbyterianism was split into two camps of "subscribers" and "non-subscribers" Out-and-out evangelical as John Abernethy was, there can be no question that he and his associates sowed the seeds of that after-struggle (1821–40) in which, under the leadership of Dr. Henry Cooke, the Arian and Socinian elements of the Irish Presbyterian Church were thrown out. In 1726 the "non-subscribers," in spite of pleading against separation by Abernethy, were cut off from the Irish Presbyterian Church. In 1730, although a "non-subscriber," he was invited to Wood Street, Dublin, whither he removed. In 1731 Abernethy made a stand against the Test Act, "against all laws that, upon account of mere differences of religious opinions and forms of worship, excluded men of integrity and ability from serving their country." He was nearly a century in advance of his age in his repudiation of tests and disabilities. He had to reason with those who denied that a Roman Catholic or Dissenter could be a "man of integrity and ability." His *Tracts*—afterwards collected—did fresh service, generations later, and his name is honoured by all who love freedom of conscience and opinion.

*See* Dr. Duchal's *Life*, prefixed to *Sermons* (1762); *Diary* in ms., 6 vols. 4to; Reid's *Presbyterian Church in Ireland*, iii. 234.

**ABERNETHY, JOHN** (1764–1831), British surgeon, was born in London on April 3 1764. He was apprenticed in 1779 to Sir Charles Blicke, then assistant surgeon to St. Bartholomew's Hospital, and studied under Sir William Buzard at the London Hospital and under John Hunter. When Blicke became surgeon to the hospital, Abernethy became assistant surgeon. He began to lecture to students in his house. The lectures were so crowded that the governors of the hospital decided to build a regular lecture theatre. Abernethy's best known work is *Surgical observations on the constitutional Origin and Treatment of Local Diseases* (1809). He had enjoyed great celebrity in private practice, enhanced it is said, by his rough manners. He was surgeon to the hospital 1815–27, and died at Enfield April 20 1831.

A collected edition of his works was published in 1830. A biography, *Memoirs of John Abernethy*, by George Macilwain, appeared in 1853.

**ABERRATION IN OPTICS, SPHERICAL AND CHROMATIC**, the deviation of light rays from certain points through which they should pass in order to satisfy the conditions necessary for distinct focus. *Spherical* aberration results in distortion of the image, and *chromatic* aberration produces coloured fringes around an otherwise white image (*See* OPTICS; PHOTOGRAPHY *Apparatus*)

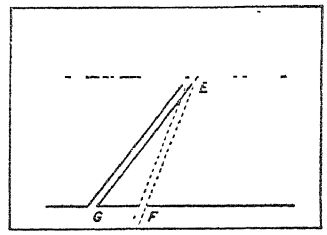
**ABERRATION OF LIGHT.** This is an astronomical phenomenon depending on the fact that light is not propagated instantaneously Our observations of the heavenly bodies are taken from the earth, a planet whose speed of motion is not incomparably smaller than that of the light; the result is that the apparent position of a star in the sky does not correspond to its true direction from the earth We are accustomed to assume intuitively that a body is "where we see it to be"; or, since the distance cannot always be judged, that at any rate it is in the direction in which we see it But actually vision gives only an indirect acquaintance with its position. That which affects our eyes is the light which has travelled to us from the object; we have, therefore, to take into consideration the circumstances of propagation of the light. It is well known that a light-ray changes direction in passing from one transparent medium to another, *e g*, water to air, and that its course is curved in a medium of varying density such as our atmosphere; an object seen by these dislocated or curved rays is displaced from its correct position, and the corresponding correction for *refraction* by the earth's atmosphere is highly important in determining the positions of stars The correction for *aberration* is also concerned with the propagation of light; it arises from the fact that our actual judgment of the direction of a ray involves a combination of the earth's motion and the motion of the light.

The most elementary explanation can be given in terms of the old corpuscular theory of light—which was the theory accepted at the time aberration was discovered. If we think of the ray of light as a stream of missiles proceeding from the star with a speed of 186,0000m. a second, it is clear that the apparent direction from which the missiles come will be affected by our own velocity if that is not too insignificant in comparison. A common illustration is that of a man walking through a rain-storm with the drops falling vertically; the faster he walks, the more inclined is the position in which he must hold his umbrella to shield off the "missiles." The argument can be re-stated in terms of the wave theory of light without essential alteration; but reference should be made to an account of that theory for an explanation of the signification of "rays of light."

A rough way of alining the direction of a star is to point a long narrow tube so that we can see the star through it. The alinement is given by the two apertures at the ends of the tube, which must be such that the small pencil of rays admitted through one can make an exit through the other and thus reach the observer's eye. The upper part of the diagram shows the rays of light coming from a star; the upper aperture E admits a narrow beam which continues in the original direction, so that F is the position in which the exit aperture has to be placed. Suppose that whilst the light travels the distance E F the earth moves through a distance G F; then the required direction of our tube is G E. It will then admit the light at E, and, by the time the light has travelled down the tube, the lower aperture will have reached the position F and the light will pass out. It will be seen that the tube G E does not point in the true direction of the star F E. The same principle applies when the tube is furnished with lenses, as in a telescope.

The alinement is the same whether the tube is long or short, and we can conveniently appreciate the relative proportions if we take E F to be 186,000 miles. The light then takes 1 second to pass from E to F; and in 1 second the earth travels in its orbit 18½m, represented by G F. Thus G F is $\frac{1}{10,000}$ of E F. The greatest possible angle between the observed direction and the true direction is $\frac{1}{10,000}$ of a radian, or more accurately 20·47″;

this is called the *constant of aberration* For comparison the apparent radius of Jupiter is about 20″; so that (when the aberration is a maximum) we see the centre of Jupiter when we are actually looking towards the edge of disc. As the direction of the earth's motion changes throughout the year so the direction of the aberration displacement of the star changes; the star is always displaced towards the "apex of the earth's way," *i.e.*, the point of the sky towards which the earth's motion is directed. The star apparently moves in an ellipse around its true position as centre, making a circuit once a year. For a star at the pole of the ecliptic this ellipse is a circle of radius 20·47″; for other parts of the sky the path may be regarded as a parallel circle which is projected into an ellipse by foreshortening. The major axis of the ellipse is always 20·47″, but the minor axis depends on the latitude (*i.e.*, distance from ecliptic) of the star.




**Discovery of Aberration.**—The discovery of the aberration of light in 1725, due to James Bradley (1693–1762) is one of the most important in the whole domain of astronomy; and in pure physics it has provoked a succession of investigations culminating in the theory of relativity. It was entirely unexpected, and it was only by extraordinary perseverance and perspicuity that Bradley was able to explain it in 1729. The discovery arose in the course of an attempt to discover whether the stars had appreciable parallaxes. We now know that stellar parallaxes are less than a second of arc, and the first authentic parallax was not measured until a century later. Many observers had, however, claimed to have discovered such parallaxes. In 1680 Jean Picard in his *Voyage d'Uraniborg* stated, as the result of ten years' observations, that the Pole Star exhibited variations of position amounting to 40″ annually; some astronomers endeavoured to explain this by parallax, but the motion was at variance with that which parallax would occasion. J. Flamsteed, from measurements in 1689 and succeeding years with his mural quadrant, concluded that the declination of the Pole Star was 40″ less in July than September. R. Hooke in 1674 concluded from his observations that γ Draconis was 23″ more northerly in July than October.

When James Bradley and Samuel Molyneux entered this sphere of astronomical research in 1725 there was much uncertainty as to whether genuine stellar parallaxes had been detected or not; and it was with the intention of answering this question definitely that they erected a large telescope in the house of the latter at Kew. They determined to re-investigate γ Draconis, a star selected because it passed almost through the zenith in the latitude of London; its position would therefore not be affected by troublesome and uncertain corrections for refraction. The telescope constructed by George Graham (1675–1751), a celebrated instrument-maker, was affixed to a vertical chimney-stack; the eye-piece could be moved a little laterally so as to measure deviation from the vertical by means of a screw, the vertical being fixed by a plumb-line. The first observations were made on the 3rd, 5th, 11th, 12th Dec., 1725. On the 17th Bradley found the star to be moving southwards, and confirmed this on the 20th. (The change of position by aberration at this time of the year is rapid, and amounts to about 3·2″ in ten days.) The star was found to continue its southerly course until March when it was about 20″ south of the December position. By the middle of April it was apparent that it was returning north again. In September it reached its northerly limit, the extreme range between March and September being 40″.

Although the observers were seeking an apparent shift of the star, they immediately realized that what they had found could not be attributed to parallax. The maximum range of parallactic shift for γ Draconis should be between June and December. Aberration and parallax are easily distinguished by this three months' difference of phase; the displacement of a star due to aberration is always at right angles to that due to parallax. Bradley and Molyneux discussed several hypotheses in the hope of arriving at an explanation. One hypothesis was that the direction of the earth's axis and therefore of the plumb-line varied, causing an apparent displacement of the star when its position was measured with respect to the plumb-line Observations were therefore made of another star on the opposite side of the pole; from a comparison of the displacements with those of γ Draconis it was found that they could not be explained by a shift of the earth's axis The precaution, however, was fruitful; for by long continued observation Bradley ultimately established that shifts due to a change of the earth's axis actually occurred; and he was led to his second famous discovery—*nutation*. Bradley realized that observations of many more stars were required in order to determine the laws governing this mysterious effect. For this purpose he set up a more convenient telescope at the Rectory, Wanstead, the residence of the widow of his uncle, James Pound, who had guided him in his early astronomical work. This telescope, erected in Aug. 1727 had a range of 6¼° on each side of the zenith and thus covered a much larger area of the sky than the Kew instrument. Fifty stars were kept under close observation. Bradley disentangled from these observations the conclusion that a star had its extreme declinations at the times of the year when it passed through the zenith at 6 o'clock morning or evening.

The true theory of the phenomenon was discovered by an accident reminding us of the more apochryphal story of Newton and the apple-tree. Sailing on the Thames, Bradley noticed the shifting of the vane on the mast, as the boat altered her course; the shift was not due to unsteadiness of the wind, but to the combining of the changing motion of the boat with the steady velocity of the wind. This suggested that the changing direction of the ray from the star was the result of combining the changing motion of the earth with the steady velocity of the starlight. The finite velocity of light had been discovered by Roemer 60 years earlier

**Astronomical Effects.**—In modern astronomy the aberration due to the earth's orbital motion is included along with precession and nutation as part of the "star correction" applied to reduce from Apparent to Mean Place. A small correction for diurnal aberration is also applied, arising from the motion of the observer caused by the diurnal rotation of the earth. For planets and comets a different procedure is adopted. It must be remembered that, even after allowing for the aberration, we see the body not where it is now but where it was when the light left it. Thus the corrected direction F E joins the position of the earth at the instant of observation to the position of the planet some minutes or hours before. Using the previous diagram but with a new connotation, let E be the planet when the light left it, and let F be the position of the earth when the light arrives. Whilst the light travels from E to F the earth travels from G to F, so that the *apparent direction* of the planet G E is the actual direction joining the positions of the earth and planet *at the time when the light left the planet.* Accordingly we do not trouble about the hybrid direction F E. We accept G E uncorrected; but we apply a correction to the time of observation, antedating it by the light-time. This simple procedure is inapplicable to the stars whose light-time is many years, because it assumes that the earth's velocity has been constant throughout the interval. But it answers a question often raised—whether we ought not to apply a correction on account of the aberration due to the motion of the whole solar system through space towards a point in Hercules. This motion, being uniform, admits of the above treatment; and the answer is that no correction is required provided that it is understood that the observation relates to the state of things when the light left the star; the aberration rather helpfully "puts back the sun" to the earlier date which must in any case pertain to the star.

Since the velocity of light is known with great accuracy the observed value of the constant of aberration determines the earth's orbital velocity. This can also be calculated when we know the radius of the earth's orbit from observations of the solar parallax. There has long been a rivalry between the constant of aberration and the solar parallax as to which shall provide the more accurate determination; at present the degree of

accuracy seems to be about equal, and the two methods are in satisfactory accord.

**Aberration and Aether.**—In the explanation of aberration we pictured the light as travelling in a straight line from the star uninfluenced by the motion of the earth carrying the observer. On the wave theory this would not be true if the aether in our neighbourhood were carried along with the earth; for when the light reaches this moving region of the aether its course will be disturbed, the motion of the aether (if the phrase has any literal meaning) being superposed on the ordinary velocity of the light traversing it. According to the modern idea of the atom, introduced by Rutherford in 1911, the electrons and atomic nuclei are so minute that the aether can slip through the void interior of the atom as easily as through the solar system, and there is no longer any reason to anticipate a convection; but in the last century it seemed almost contrary to reason to imagine solid matter pushing its way through the aetherial medium without serious disturbance. Apart from this prejudice, experimental evidence in the last century suggested that the aether in the lower part of our atmosphere was travelling with the earth, and further that moving matter such as a stream of water partially dragged the aether with it. Thus in 1818 Arago pointed out that the refraction by a prism (depending on the ratio of the velocities of light in air and glass) ought to be altered by the motion of the prism through the aether; since no such alteration was observed he concluded that the surrounding aether shared the motion of the prism. Fresnel explained this effect by a "dragging co-efficient," his hypothesis being that the "condensed" aether carrying the light inside the prism did not have the full motion of the prism but was only partially dragged in the same direction This was apparently verified by Fizeau in 1851, who sent light in opposite directions round a circulating stream of water and thus studied its velocity with and against the current. In 1871 Airy performed his water-telescope experiment (originally suggested by Boscovitch) in which he measured the constant of aberration with a telescope that had its tube filled with water. Reasoning crudely, the aberration should have been increased, since the velocity of light in water is less than in air; but the normal value was obtained. Fresnel had already predicted that there would be a compensation when account was taken of the alteration of refraction at the surface of the moving liquid.

In the light of Fresnel's theory, it seemed to emerge from these results that the aether-drag was limited to the interior of the moving bodies, and that its effects were compensated by changes of refraction at the surface of the bodies, except when (as in Fizeau's experiment) differential motions were concerned. Thus the aether just outside the solid earth would be stagnant as the theory of aberration requires. But in 1887 Michelson and Morley made a much more delicate attempt to detect the difference of velocity of the earth and surrounding aether (*see* RELATIVITY); this seemed to decide that the aether was carried with the earth. Thus the conflict between stagnant and convected aether was brought to a head, the former being demanded by astronomical aberration and the latter by the Michelson-Morley experiment and certain later experiments involving similar principles.

The astronomical observations prove that the ray as it reaches the telescope is travelling in the same direction as when it started from the star; this, however, does not entirely rule out possible motions of the aether near the earth. It was shown by Sir George Stokes (1845) that the necessary and sufficient condition was that the motion should be of the kind known as "irrotational" in hydrodynamics. This would allow the kind of disturbance which might be anticipated from the earth's pushing its way through a fluid aether, since there is a well-known irrotational solution of the problem of a sphere moving through a liquid; but it does little to help the present difficulty since it involves a sliding of the aether over the surface of the sphere, which is precisely the point denied by the Michelson-Morley experiment. If the aether is allowed to be compressible (the density having, however, no effect on the velocity of light) an irrotational solution can be found which does not involve any slip of the aether at the earth's surface. This was pointed out by Planck, but the condensation required is so extreme, that the loop-hole cannot be considered very seriously. The reconciliation was ultimately effected by the theoretical investigations of Lorentz and Larmor. Their work showed that the electrical structure of matter involves an alteration of length of all material objects in the direction of their velocity through the aether, which would compensate the effect looked for in the Michelson-Morley experiment—confirming a suggestion originally made by F. [illegible] allowance is made for this contraction, none of the numerous experiments are capable of testing the relative motion of the earth and aether. The position about 1900–05 can be summed up as follows:—The earth moves through the stagnant aether without disturbing it, as the original explanation of astronomical aberration demands. The objection that bodies carried on the earth show no effects of this relative motion falls to the ground because it turns out that in all the experiments the effects are precisely compensated. For the further developments originating from these ideas reference should be made to the article RELATIVITY.

Astronomical aberration provides no means of determining a uniform motion through the aether; this will be apparent from what we have said as to the aberration from the motion of the solar system through space. But it [illegible] means of determining differences of velocity, such as [illegible] in the earth's orbital motion at different times of the year. Equally it can test any possible difference of aether-drift at different levels, *e.g.*, at the top and bottom of a mountain. Prof. D C. Miller's recent attempt to test this by performing the Michelson-Morley experiment at the top of a mountain appears to us to have been misconceived; for even if (contrary to current theory) the experiment can reveal aether-drift, it is by no means comparable in accuracy with the test by astronomical observations, which assure us that the light of the stars is not deflected by any change of the aether current between a mountain observatory and the sea-level. All observable effects of aberration are due to relative velocity or change of velocity. On absolute velocity it is silent; and there is reason to believe that all other experiments are silent also—a conclusion which has led to the principle of relativity.

BIBLIOGRAPHY.—For Bradley's work *see* S. Rigaud, *Memoirs of Bradley* (1832) or H. H Turner, *Astronomical Discovery* (1904). The practical application in astronomy is treated in all text-books on spherical astronomy For the long controversy regarding stagnant and convected aether *see* J. Larmor, *Aether and Matter* (1900) and E. T Whittaker, *A History of the Theory of Aether and Electricity* (1910). (A. S. E.)

**ABERSYCHAN:** *see* PONTYPOOL.

**ABERTILLERY,** urban district, Monmouthshire, England, 16 mi. N W. of Newport, on the G.W.R. Pop. (1938) 28,320. Area, 10.1 sq mi. It lies in the mountainous mining district of Monmouthshire and Glamorganshire, in the valley of the Ebbw Fach, and the large industrial population is mainly employed in the numerous coal mines, ironworks and tinplate works. The upper reaches of the valley were formerly important as iron smelting regions and coal was worked early at Abertillery. This region, like most of South Wales, suffered badly in the depression of the 1930s.

**ABERT RIM,** a striking rock formation in south central Oregon, U.S.A., is one of the largest fault scarps in the world. The rim runs along the eastern edge of Abert lake for 19 mi., rising about 2,000 ft. above the lake, and has an 800-ft. lava cap ending in a sheer precipice.

Lieut. John Charles Frémont and his men discovered Abert Rim and lake in Dec. 1843. Legend says that a party of Indians chased a wagon train of white people across the level plateau which slopes gradually from the east up to the summit of the rim, and drove them, unsuspecting, over the cliff. In the vicinity of Abert lake are found crude pictographs on rocks, rock foundations of dwellings of primitive people, arrowheads and skeletons.

Rhinoceros and camel fossil remains, and those of many other animals have been found nearby.

**ABERYSTWYTH** (ab-ur-ŭst'with), municipal borough, watering place and university town, in the Cardiganshire parlia-

mentary division, on the shores of Cardigan bay, Wales, at the mouth of the artificially united Rheidol and Ystwyth rivers. Pop (est. 1938) 9,309. Area, 1.78 sq.mi There appears to be a long tradition of settlement in the neighbourhood, for on a prominent hill (Pendinas) overlooking the south of the town is one of the largest hill-top earthworks in central Wales. With the clearing of the lowland, Pendinas was superseded by Llanbadarn Fawr, a village situated on a dry bend above the flood plain of the Rheidol about 1½ mi. E. of the town The existence of three Norman motte and bailey castles in the neighbourhood suggests loose military tenure in early Plantagenet times. The most interesting of these sites is Castell Aberystwyth situated above the bend of the Ystwyth about 1½ mi S. of the town. It gave its name to the Edwardian stone castle erected near the fishing village that grew up at the river mouths. The history of the castle was a troublesome one, as was to be expected from its position in the heart of Wales, but future developments centred in the little community that gathered beneath it, and not in Llanbadarn Fawr. Traces of the mediaeval town wall are still to be seen.

Aberystwyth shared in the mining (lead), agricultural and sea trade movements of the early 19th century and seems to have become at this time the social centre for the surrounding area. It has since extended northwards and eastwards over the newly drained marshy ground that surrounded the mediaeval settlement, and has gained favour as a summer health resort, especially since the development of the railway. The latter, however, killed the coastal trade and much of the seafaring habit; the harbour is now derelict (*see* CARDIGANSHIRE). As a link between the northern and southern parts of Welsh Wales, Aberystwyth became the site of the first University college of Wales, opened in 1872 and incorporated by charter in 1889, and of the National Library of Wales, opened in 1911. In 1906 the Welsh Calvinistic Methodist Theological college was moved here from Trevecca Aberystwyth, whose first charter was granted in 1277, was a contributory parliamentary borough until 1885. A town planning scheme is in operation.

**ABETTI, ANTONIO** (1846–1928), Italian astronomer, was born on June 19, 1846, at Gorizia, Italy He was educated at Pisa. After working in the observatories at Pisa and Padua, Abetti became director of the Arcetri observatory, Florence, in 1894; he remained there until he retired in 1921. He made a special study of the minor planets and wrote a number of papers on this subject. Abetti was a member of the Academie dei Lincei; he died on Feb. 20, 1928.

Abetti wrote *Construction of a Sundial in a Vertical Plane* (1876); *Differences in Longitude between Rome, Padua and Arcetri* (1891), *Annals of Arcetri Observatory* (1896–1911).

**ABETTOR,** a law term implying one who is present, actually or constructively, and aids and abets another to commit an offence. An abettor differs from an accessory (*q.v.*) in that he must be present at the commission of the crime; all abettors (with certain exceptions) are principals in the second degree, and, in the absence of specific statutory provision to the contrary, are punishable to the same extent as the actual perpetrator of the offence.

**ABEYANCE,** a state of expectancy in respect of property, titles or office, when the right to them is not vested in any ascertained one person, but awaits the appearance or determination of the true owner. In law, the term abeyance can only be applied to such future estates as have not yet vested or possibly may not vest. The freehold of a benefice, on the death of the incumbent, is said to be in abeyance until the next incumbent takes possession. A common use of the term is in the case of peerage dignities. If a peerage which passes to heirs-general, like the ancient baronies by writ, is held by a man whose heir-at-law is neither a male, nor a woman who is an only child, it goes into abeyance on his death between two or more sisters or their heirs, and is held by no one till the abeyance is terminated; if eventually only one person represents the claims of all the sisters, he or she can claim the termination of the abeyance as a matter of right. The Crown can also call the peerage out of abeyance at any moment, on petition, in favour of any one of the sisters or their heirs between whom it is in abeyance It is common, but incorrect, to speak of peerage dignities which are dormant (*i.e.*, unclaimed) as being in abeyance. (*See* PEERAGE)

**ABGAR,** a name borne by a line of Mesopotamian kings, 29 in number, who reigned in Osrhoene and had their capital at Edessa in the last century before and the first century after the birth of Christ According to an old tradition, one of these princes, perhaps Abgar V. (Ukkāmā or Uchomo, "the black"), being afflicted with leprosy, sent a letter to Jesus, acknowledging his divinity, craving his help and offering him an asylum in his own residence, but Jesus wrote a letter declining to go, promising, however, that after his ascension he would send one of his disciples. Eusebius states that in due course Judas, son of Thaddaeus, was sent (A.D. 29). The letters are given by Eusebius (*Eccl Hist.* i. 13), who declares that the Syriac document from which he translates them had been preserved in the archives at Edessa from the time of Abgar.

This legend has survived in various forms, and has given rise to much discussion The correspondence was rejected as apocryphal by Pope Gelasius and a Roman synod (*c.* 495), though, it is true, this view has not been shared universally by the Roman Church. Among Protestants the spuriousness of the letters is almost universally admitted. Lipsius (*Die Edessenische Abgarsage,* 1880) has pointed out anachronisms which seem to indicate that the story is quite unhistorical. The first king of Edessa of whom we have any trustworthy information is Abgar VIII bar Ma'nu (A.D. 176–213). It is suggested that the legend arose from a desire to trace the Christianizing of his kingdom to an apostolic source.

*See* Lipsius, *Die Edessenische Abgarsage kritisch untersucht* (1880); Tixeront, *Les Origines de l'église d'Edesse et la légende d'A.* (1888); for the Epistles *see* APOCRYPHAL LITERATURE, sect. "Epistles."

**ABGESANG:** *see* AUFGESANG.

**ABHIDHAMMA,** the name of one of the three divisions into which the Buddhist scriptures are divided (*see* BUDDHA AND BUDDHISM). It consists in the Pali Canon of seven works: 1. *Dhammasangani* (enumeration of mental states). 2. *Vibhanga* (analysis). 3. *Kathā-vatthu* (subjects of discussion). 4. *Puggala-paññatti* (on classes of individuals). 5. *Dhātu-kathā* (on mental elements). 6. *Yamaka* (pairs of ethical states). 7. *Paṭṭhāna* (relations of ethical states). These have been published by the Pali Text society, and the first, third and fourth have been translated (*see* below). Most of the works consist of the analysis and classification of psychical states from an ethical standpoint, but the *Kathā-vatthu* gives a list of dogmas disputed between the 18 sects. The Ceylon Chronicles say that it was spoken or promulgated (not composed) by Tissa Moggaliputta at the third council in 247 B.C. As Mrs. Rhys Davids has shown, it must have been compiled gradually. It is probably one of the latest of the works, but none of them are primitive, and some schools, according to Tāranātha, denied that Abhidhamma was the word of Buddha. The oldest name for this literature is *mātikā,* "lists," *i.e.* of the questions discussed, and it is mentioned under this name in several parts of the canon, but from this nothing can be inferred as to the age of the extant works. The Sarvāstivāda school had a similar set of seven works, which exist now only in a Chinese version. They have been analysed by Prof. Takakusu in the article mentioned below. The subject was first examined by Burnouf, who relied on the Mahāyāna canon as found in Tibetan, in which Abhidharma (Pāli, Abhidhamma) is represented by the *Prajñāpāramitā* and such works. These teach a doctrine of negativism, or as Prof. Stcherbatsky terms it, relativity, and hence Abhidharma was translated "metaphysics." But this is quite absent from the earlier schools, in which the term means "higher dharma."

See *Buddhist Psychology,* translation of *Dhamma-sangani,* and *Points of Controversy,* translation of *Kathā-vatthu,* by Mrs. Rhys Davids (1900 and 1915); E. Burnouf, *Introduction à l'histoire du bouddhisme indien* (1845); Tāranātha, *Geschichte des Buddhismus,* translated by A. Schiefner, St. Petersburg, 1869; "On the Abhidhamma books of the Sarvāstivādins," by Prof. Takakusu, in *Journal of the Pāli Text Society,* 1905; *Designation of human types,* translation of *Puggala-paññatti,* by B. C. Law (1924). (E. J. T.)

**ABHORRERS,** the name given in 1679 to the persons who expressed their "abhorrence" at the action of those who had signed petitions urging King Charles II to assemble parliament. Feeling against Roman Catholics, and especially against James, duke of York, was running strongly; the Exclusion bill had been passed by the house of commons, and the popularity of James, duke of Monmouth, was very great. To prevent this bill from passing into law, Charles had dissolved parliament in July 1679, and in the following October had prorogued its successor without allowing it to meet He was then deluged with petitions urging him to call it together, and this agitation was opposed by Sir George Jeffreys (*q v.*) and Francis Wythens, who presented addresses expressing "abhorrence" of the "Petitioners," and thus initiated the movement of the ABHORRERS, who supported the action of the king. "The frolic went all over England," said Roger North, and the addresses of the Abhorrers which reached the king from all parts of the country formed a counterblast to those of the Petitioners. It is said that the terms Whig and Tory were first applied to English political parties in consequence of this dispute. (*See* WHIG AND TORY.)

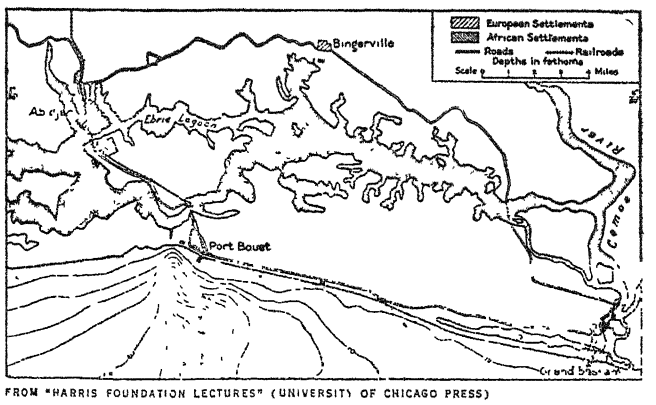
**ABIATHAR,** in the Old Testament, son of Ahimelech, priest of Nob. He alone escaped from the massacre carried out by Doeg. Fleeing to David, he remained with him throughout his wanderings and his reign. He was loyal through the rebellion of Absalom, but supported Adonijah against Solomon, and was banished to Anathoth. He probably represents an early rival house to that of Zadok, the official priestly family of Jerusalem down to the exile. (*See* especially I Sam. xxii, *seq.*, II Sam. xv, xx, I Ki i, ii, iv.)

**ABICH, OTTO WILHELM HERMANN VON** (1806–1886), German mineralogist, geologist and traveller, was born in Berlin on Dec. 11, 1806, and died in Vienna on July 1, 1886. His earliest scientific work related to spinels and other minerals, and later he made special studies of fumaroles, of the mineral deposits around volcanic vents and of the structure of volcanoes. The mineral abichite was named after him.

His works include: *Vues illustratives de quelques phénomènes géologiques, prises sur le Vésuve et l'Etna, pendant les années 1833 et 18[illegible]* (Berlin 1836); *Ueber die Natur und den Zusammenhang der [illegible] Bildungen* (Berlin 1841); *Geologische Forschungen in den Kaukasischen* [illegible] 1878, 1882 and 1887).

**ABIDJAN** (5° 27′ N., 4° W.), is the rising, government-fostered metropolis of Ivory Coast, French West Africa. Its pop. (17,500, official est. 1936) makes it the largest centre in the colony (8th in F.W.A.); in European inhabitants (1,060) it is materially outranked only by Dakar. It stands on a low promontory of the mainland shore of Ebrié lagoon, opposite a place where the sand bar that forms the coastline is narrow (875 yd.), and a submarine valley, the Bottomless Pit, brings deep water close to shore (*see* map).

The town dates from 1903, when it was made the terminus of a railroad penetrating the dense coastal forest. Subsequent extensions of the rails enhanced its commercial value, but for a generation want of port facilities prevented its growth. Attempts to maintain a canal through the bar in 1906–08 failed. In 1923 Ebrié lagoon was linked to its neighbour next west by a 7 mi. canal, making a waterway 125 mi. long navigable for small craft. Later the railroad was extended 7 mi. (via causeway and pontoon bridge across the lagoon) to an ocean terminal on the bar, Port Bouet. There a 1,350-ft. pier projecting beyond the breakers to expedite lighterage has been in use from 1931. This gives Abidjan wharf facilities equivalent to the original port of the vicinity—Grand Bassam, a typical *comptoir* set up about 1850 on the bar 22 mi. east, where the Comoe river brings down timber, an early and still important product In 1934 the capital of Ivory Coast colony was moved to Abidjan from Bingerville (on the mainland 9 mi. east), the remaining European station of the district. Combined advantages have promoted Abidjan's growth, partly at the expense of its neighbours. There remains at Bingerville an agricultural station, and at Grand Bassam the superior law court, besides some port business and the squaring of logs for export. World War II halted a project to cut the bar and build jetties immediately west of the Bottomless Pit, to permit ocean shipping to berth at Abidjan, where the lagoon is 45 ft. deep.



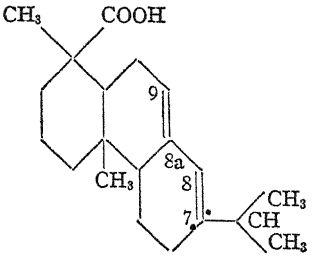

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The town plat covers the full width of its peninsular site, with government buildings and the commercial centre adjacent to the proposed port at the tip. Residences and miscellaneous services scatter on either side of the central thoroughfare, which leads to the main highway north. City lots ranged in blocks take the place of the traditional African compounds. Two residential suburbs for Africans are separated from the European town, one by the lagoon, the other by a wooded tract. All sections are serviced with electricity, and with water pumped from municipal wells sunk 60–80 ft. into a sandy substratum adequate for all presumptive needs. There are semiofficial chambers of commerce and agriculture, and a government hospital. Motor roads reach the near-by settlements, and two motorable routes penetrate the colony as part of the intercolonial highway system. (D. WH.)

**ABIETIC ACID.** The term abietic acid has been used indiscriminately to describe a number of resin-acid mixtures and, in some cases, purified naturally-occurring rosin. Abietic acid actually is a pure chemical compound with molecular formula $C_{20}H_{30}O_2$; it is a representative of the naturally-occurring resin acids with the same formula. These latter, in turn, are the major constituents of gum oleoresin, the exudate that flows from the trunks of conifers upon systematic scarification, and of the rosin (colophony) that is solvent-extracted from the aged stumps of pine trees. The name abietic acid was derived from the species of French pine, *Pinus abies,* from which the acid was first isolated (F. Schulz) in 1917. In the United States, however, the long leaf (*Pinus palustris*) and slash pines (*Pinus caribaea*) are the chief sources of rosin in which 30%–40% abietic acid is present.

The pure acid crystallizes from methanol, upon the addition of water, as triangular plates in the monoclinic system with a melting point of 171°–175° C., and an optical rotation of $[\alpha]_D^{24}-106°$ (of a 1% solution in absolute ethanol). It exhibits its most intense absorption band in the ultra-violet region at 241 mμ wave length. In characterizing resin acids, only the last two properties, optical rotation and ultra-violet absorption are used since the melting points of these substances are not indicative of degree of purity. The acid is soluble in all common organic solvents.

Abietic acid was shown (L. Ruzicka) to be a carboxylic acid derivative of trimethylisopropylhydrophenanthrene, which has the molecular formula $C_{20}H_{32}$. Absorption in the ultra-violet region at 241 mμ indicated the presence of a system of double bonds conjugated between two rings. Their positions were eventually proved (Louis F. Fieser, William P. Campbell, L. Ruzicka) to be those shown in the following formula.



Upon treatment of abietic acid with strong acids, an equilibrium mixture of isomeric acids is formed which contains approximately 85% of the original acid. If the free acid is heated at high temperatures, a similar effect is observed, although the final equilibrium achieved by this process does not have the same composition as that prepared by acid isomerization. Because of this tendency of abietic acid for isomerization and its tendency to undergo air oxidation, it must be kept out of contact with strong acids and air during reactions and while being held in storage.

The pure acid is isolated from rosin in the following manner: the rosin is first isomerized with mineral acid to increase the abietic acid content from 35% to 50%. An acetone solution of the isomerized rosin is treated with diamylamine to obtain the crystalline, insoluble salt of abietic acid which is recrystallized to the optimum rotation, $[\alpha]_D^{24}-60°$, and the pure acid with rotation $[\alpha]_D^{24}-106°$, isolated by decomposition of the salt with boric acid.

For determining the purity of a sample or the amount of abietic acid in a mixture, the ultra-violet absorption characteristics of the sample are compared with those of a pure reference sample.

Rosin, which contains 30%–40% of abietic acid, is composed of 90% of similarly constituted resin acids. It is one of the least expensive sources of organic acids available in large quantities and hence is used extensively to produce many commercial products of which the following are examples: the sodium soap of rosin and modified rosins find use in three large industries, in synthetic rubber production as an emulsifying agent, in paper-making for sizing and in soap manufacture. The heavy metal salts, prepared from the sodium salts, are used as driers for paints and varnishes, as hardening agents for rosin and as antifouling agents in paints. Monohydric and polyhydric alcohol esters of rosin are used extensively in the paint and varnish industry. Valuable resins with outstanding properties of light resistance and compatibility have been prepared by the addition of maleic anhydride to rosin followed by esterification with monohydric or polyhydric alcohols. Decarboxylated rosin, known as rosin oil, is used extensively in greases, rubber reclaiming, foundry core compounds, linoleums and shoe polishes. (G. C. HA.)

**ABIGAIL** (Heb. *Abigayil,* perhaps "father is joy"), or ABIGAL (II Sam. iii, 3), in the Bible, the wife of Nabal the Carmelite of southern Judah, on whose death she became one of the earlier wives of David (I Sam. xxv). By her David had a son, whose name appears in the Hebrew of II Sam. iii, 3 as Chileab, in the Septuagint as Daluyah and in I Chron. iii, 1 as Daniel. The name Abigail was also borne by a sister of David's (II Sam. xvii, 25; I Chron. ii, 16 *f.*). From the former (self-styled "handmaid" I Sam. xxv, 25 *f.*) is derived the 16th and 17th century colloquial use of the term for a waiting woman (*cf.* Abigail, the "waiting gentlewoman," in Francis Beaumont and John Fletcher's *The Scornful Lady*).

**ABIJAH** (Heb. *Abiyyah* and *Abiyyahu,* "Yah is father"), a name borne by nine different persons mentioned in the Old Testament, of whom the most noteworthy are the following. (1) The son and successor of Rehoboam, king of Judah (II Chron. xii, 16; xiii), reigned about two years (918–915 B.C.). The accounts of him in the books of Kings and Chronicles are very conflicting (compare I Kings xv, 2 and II Chron. xi, 20 with II Chron. xiii, 2). The Chronicler tells us that he has drawn his facts from the Midrash (commentary) of the prophet Iddo. This is perhaps sufficient to explain the character of the narrative. (2) The second son of Samuel (I Sam. viii, 2; I Chron. vi, 28 [13]). He and his brother Joel judged at Beersheba. Their misconduct was made by the elders of Israel a pretext for demanding a king (I Sam. viii, 4). (3) A son of Jeroboam I, king of Israel; he died young (I Kings xiv, 1 *ff.*, 17). (4) Head of the eighth order of priests (I Chron. xxiv, 10), the order to which Zacharias, the father of John the Baptist, belonged (Luke i, 5).

The alternative form ABIJAM is probably a mistake, though it was upheld by M. Jastrow.

**ABILA,** (1) generally called Abila of Pausanias to distinguish it from (2) below. It was the capital of the tetrarchy of Abilene in ancient Syria and an important town on the road between Damascus and Baalbek (Heliopolis). Ruins and inscriptions at the modern village of Sūq Wādī Baradā mark its site, which, though the names have no connection, is one of the traditional burial places of Abel. Early Arab geographers called it Ābil Al Sūq. According to Josephus, Abilene was a separate Iturean kingdom till A.D. 37, when Caligula granted it to Agrippa I; in 52 Claudius granted it to Agrippa II (*See* also LYSANIAS.) (2) A city of Perea (modern north Jordan) represented by ruins of Ābil Al Zait.

**ABILDGAARD, NIKOLAJ ABRAHAM** (1744–1809), Danish painter, was born at Copenhagen, the son of Sören Abildgaard, an antiquarian draughtsman of repute He formed his style on that of Claude Lorrain and of Nicolas Poussin, and was a cold theorist, inspired not by nature but by art. As a technical painter he attained remarkable success, his tone being very harmonious and even, but the effect, to a foreigner's eye, was rarely considered to be interesting.

His works were scarcely known outside of Copenhagen, where he won an immense fame in his own generation. He was the founder of the Danish school of painting, and the master of Bertel Thorwaldsen and Kristoffer Eckersberg

**ABILENE,** a city of Kansas, U.S., on the Smoky Hill river, about 95 mi. W. of Topeka; the county seat of Dickinson county. It is on federal highway 40, and is served by the Union Pacific, the Rock Island and the Santa Fe railways. The population was 5,580 in 1950, and 5,671 in 1940 by the federal census. In the 1860s Abilene, at the end of the trail from the southwest, was one of the important centres for shipping cattle. It has a large trade in cattle, grain and poultry, and is headquarters of the store company serving variety stores in Kansas and Colorado. Its creamery has an annual output valued at $2,000,000. Flour mills and bottling works for medicinal mineral water are also important. Abilene was settled about 1860; incorporated in 1869; and adopted the commission-manager form of government in 1939. The boyhood home of Gen. Dwight D. Eisenhower is open to the public.

**ABILENE,** a city of Texas, U.S., about 150 mi. W. by S. of Fort Worth, at an altitude of 1,738 ft., almost at the geographical centre of the state; the county seat of Taylor county. It is on federal highways 80 and 83, and is served by the Texas and Pacific, the Abilene and Southern and the Wichita Valley railways and by seven motor-stage lines and Pioneer Air Lines. Between 1900 and 1920 the population increased threefold, from 3,411 to 10,274; in 1940 it was 26,612; in 1950, 47,102.

Abilene is the distributing centre for a fine farming and stock-raising district. Around it are many producing petroleum pools. It has numerous wholesale concerns, and is headquarters for many oil companies and oil-well supply firms.

Natural gas is abundant. Cottonseed and peanut products, feeds, pressed brick, dairy products, clothing, oil-field equipment, candy and watches are manufactured. The assessed valuation of property in 1950 was $56,000,000. The West Texas fair is held there. Abilene is the seat of Hendrick Memorial hospital and St. Ann hospital. There are three denominational institutions of higher learning: McMurry college (Methodist), Abilene Christian college (Church of Christ) and Hardin-Simmons university (Baptist). The city has a council-manager form of government. Its site was determined by the route of the Texas and Pacific railway. When it was extended through that region, new towns sprang up as sections were completed; and at milepost 407, on March 16, 1881, the first sale of building lots was held for the city of Abilene.

**ABILITIES, GENERAL AND SPECIAL.** These (together with personality traits, attitudes and interests) constitute the principal subject matter of "differential psychology," which deals with individual differences in these mental functions, their nature, origin, determining conditions, development measurement, interrelations and distribution. C. Spearman wrote in earlier editions of the *Encyclopædia Britannica,* "The now common term 'general ability' in its current signification is of recent origin Previously it appears to have had only occasional usage in ordinary writing and conversation, being there taken to characterize excellence in performances of several different kinds; especially when

these were not all readily subsumable under the name of 'intelligence'." Recognition by psychologists and educators of different kinds and degrees of generality and specificity among abilities has gone forward along with the multiplication and refinement of psychological tests and with attempts to define the nature of the tested abilities more accurately, by methods of factor analysis and validation studies. (*See* DIFFERENTIAL PSYCHOLOGY; INTELLIGENCE; PSYCHOLOGICAL TESTS.) (F. A. K.)

**ABIMELECH** (Hebrew for "father of [*or* is] the king"), the name of two well-known characters in the Old Testament. (1) A king of Gerar in South Palestine with whom Isaac had relations The patriarch, during his sojourn there, alleged that his wife, Rebekah, was his sister; but the king, doubting this, remonstrated with him and pointed out how easily adultery might have been unintentionally committed (Gen. xxvi). Abimelech is called "king of the Philistines," but the title is clearly an anachronism A very similar story is told of Abraham and Sarah (ch. xx), but here Abimelech takes Sarah to wife, although he is warned by a divine vision before the crime is actually committed. The incident is fuller and shows a great advance in ideas of morality. Of a more primitive character, however, is another parallel story of Abraham at the court of Pharaoh, king of Egypt (xii, 10–20), where Sarah, Abraham's wife, is taken into the royal household, and the plagues sent by Yahweh lead to the discovery of the truth.

Further incidents in Isaac's life at Gerar are narrated in Gen. xxvi (*cf.* xxi, 22–34, time of Abraham), notably a covenant with Abimelech at Beersheba (whence the name is explained "well of the oath"). By a pure error, or perhaps through a confusion in the traditions, Achish the Philistine (of Gath, I Samuel xxi; xxvii), to whom David fled, is called Abimelech in the superscription to Psalm xxxiv.

(2) A son of Jerubbaal or Gideon (*q.v.*), by his Shechemite concubine (Judges viii, 31; ix). On the death of Gideon, Abimelech set himself to assert the authority which his father had earned, and through the influence of his mother's clan won over the citizens of Shechem. Furnished with money from the treasury of the temple of Baal-berith, he hired a band of followers and slew 70 (*cf.* II Kings x, 7) of his brethren at Ophrah, his father's home. This is one of the earliest recorded instances of a practice common enough on the accession of oriental despots. Abimelech thus became king, and extended his authority over central Palestine. But his success was short-lived, and the subsequent discord between Abimelech and the Shechemites was regarded as a just reward for his atrocious massacre. Jotham, the only one who is said to have escaped, boldly appeared on Mount Gerizim and denounced the ingratitude of the townsmen toward the legitimate sons of the man who had saved them from Midian "Jotham's fable" of the trees who desired a king may be foreign to the context; it is a piece of popular lore, and cannot be pressed too far: the nobler trees have no wish to rule over others, only the bramble is self-confident. The "fable" appears to be antagonistic to ideas of monarchy. The origin of the conflicts which subsequently arose is not clear. Gaal, a newcomer, took the opportunity at the time of the vintage, when there was a festival in the temple, to head a revolt and seized Shechem. Abimelech, warned by his deputy Zebul, left his residence at Arumah and approached the city. In a fine bit of realism we are told how Gaal observed the approaching foe and was told by Zebul, "Thou seest the shadow of the mountains as if they were men," and as they drew nearer Zebul's ironical remark became a taunt, "Where is now thy mouth wherewith thou saidst, who is Abimelech, that we should serve him? Is not this the people that thou hadst despised? Go out, I pray now, and fight with them." This revolt, which Abimelech successfully quelled, appears to be only an isolated episode. Another account tells of marauding bands of Shechemites which disturbed the district. The king disposed his men (the whole chapter is specially interesting for the full details it gives of the nature of ancient military operations), and after totally destroying Shechem, proceeded against Thebez, which had also revolted. There, while storming the citadel, he was struck on the head by a fragment of a millstone thrown from the wall by a woman. To avoid the disgrace of perishing by a woman's hand, he begged his armour-bearer to run him through the body, but his memory was not saved from the ignominy he dreaded (II Sam xi, 21) It is usual to regard Abimelech's reign as the first attempt to establish a monarchy in Israel, but the story is mainly that of the rivalries of a half-developed petty state, and of the ingratitude of a community toward the descendants of its deliverer.

ABINGDON, municipal borough, Berkshire, lying in the flat Thames valley on the Oxford border, where the small river Ock, draining the Vale of White Horse, joins the Thames. Pop. (1938) 7,989 Abingdon (Abbedun, Abendun) was famous for its abbey, which was of great wealth and importance, and is believed to have been founded in A.D. 675 by Cissa, one of the *subreguli* of Centwin. Abundant charters from early Saxon monarchs are extant confirming various laws and privileges to the abbey, and the earliest of these, from King Ceadwalla, was granted before A.D. 688 In the reign of Alfred the abbey was destroyed by the Danes, but it was restored by Edred, and an imposing list of possessions in the Domesday survey evidences recovered prosperity. William the Conqueror in 1084 celebrated Easter at Abingdon, and left his son, afterward Henry I, to be educated at the abbey. After the dissolution in 1538, the town sank into decay, and in 1555, on a representation of its pitiable condition, Queen Mary granted a charter establishing it as a free borough corporate with a common council The council was empowered to elect one burgess to parliament, and this right continued until the Redistribution of Seats act of 1885. The abbot seems to have held a market from very early times, and charters for the holding of markets and fairs were granted by various sovereigns from Edward I to George II. In the 13th and 14th centuries Abingdon was a flourishing agricultural centre with an extensive trade in wool, and a famous weaving and clothing manufacture The latter industry declined before the reign of Queen Mary, but has since been revived.

Remains of the Benedictine abbey include a beautiful Perpendicular gateway, ruins of buildings called the prior's house, and the guest house. The narrow arched bridge over the Thames dates from 1416, and was doubtless an important feature in the town's growth. Near the bridge is St. Helen's church, the fine Early English tower and Perpendicular spire of which are the principal objects in the views of the town from the river. There may be mentioned further the old buildings of the grammar school (1563) and of the charity called Christ's Hospital (1583) and the town hall, attributed to Inigo Jones.

A popular Thames-side holiday resort, Abingdon also has manufactures of clothing and carpets and a large agricultural trade. The borough is under a mayor, 4 aldermen and 12 councillors. Area 2.6 sq.mi.

For purposes of parliamentary representation Abingdon is included in the Abingdon county division.

ABINGER, **JAMES SCARLETT,** 1ST BARON (1769–1844), English judge, was born on Dec. 13, 1769, in Jamaica, where his father, Robert Scarlett, had property. In the summer of 1785 he was sent to England to complete his education, and went to Trinity college, Cambridge, taking his B.A. degree in 1789. Having entered the Inner Temple, he was called to the bar in 1791, and joined the northern circuit and the Lancashire sessions. Though he had no professional connections, by steady application he gradually obtained a large practice, ultimately confining himself to the Court of King's Bench and the northern circuit. He took silk in 1816, and from this time till the close of 1834 he was the most successful lawyer at the bar; he was particularly effective before a jury, and his income reached the high-water mark of £18,500, a large sum for that period. He began life as a Whig, and first entered parliament in 1819 as member for Peterborough, representing that constituency with a short break (1822–23) until 1830, when he was elected for the borough of Malton. He became attorney general, and was knighted when George Canning formed his ministry in 1827; and though he resigned when the duke of Wellington came into power in 1828, he resumed office in 1829 and went out with the duke of Wellington in 1830. His opposition to the Reform bill caused his severance from the Whig leaders and, having joined the Tories, he was elected, first for Colchester and

then in 1832 for Norwich, for which borough he sat until the dissolution of parliament. Appointed lord chief baron of the exchequer in 1834 he presided in that court for more than nine years.

While attending the Norfolk circuit on April 2, he was suddenly seized with apoplexy, and died in his lodgings at Bury St. Edmunds on April 7, 1844. He had been raised to the peerage as Baron Abinger in 1835, taking his title from the Surrey estate he had bought in 1813.

The qualities which brought him success at the bar were not equally in place on the bench; he was partial, dictatorial and vain; and complaint was made of his domineering attitude toward juries. But his acuteness of mind and clearness of expression remained to the end. Lord Abinger was twice married (the second time only six months before his death), and by his first wife (d 1829) had three sons and two daughters, the title passing to his eldest son, Robert (1794–1861). His second son was Gen. Sir James Yorke Scarlett (*q.v.*), leader of the heavy cavalry charge at Balaclava; his elder daughter, Mary, married John, Baron Campbell, and was herself created Baroness Stratheden (Lady Stratheden and Campbell) (d. 1860). Sir Philip Anglin Scarlett (d. 1831), Lord Abinger's younger brother, was chief justice of Jamaica.

*See* P. C. Scarlett, *Memoir of James, 1st Lord Abinger* (1877); Foss, *Lives of the Judges;* E. Manson, *Builders of our Law* (1904).

**ABINGTON, FRANCES** (1737–1815), English actress, was the daughter of a private soldier named Barton, and was, at first, a flower girl and a street singer. She then became servant to a French milliner, obtaining a taste in dress and a knowledge of French which afterward stood her in good stead. Her first appearance on the stage was at the Haymarket in 1755 as Miranda in Susanna Centlivre's *The Busy Body*. In 1756, on the recommendation of Samuel Foote, she became a member of the Drury Lane company, where she was overshadowed by Hannah Pritchard and Kitty Clive. In 1759, after an unhappy marriage with her music-master, one of the royal trumpeters, she is mentioned in the bills as Mrs. Abington.

Her first remarkable success was in Ireland as Lady Townley, and it was only after five years, on the pressing invitation of David Garrick, that she returned to Drury Lane. There she remained for 18 years, and created more than 30 important characters, notably Lady Teazle (1777). Her Beatrice, Portia, Desdemona and Ophelia were no less liked than her Miss Hoyden, Biddy Tipkin, Lucy Lockit and Miss Prue.

It was in the last character in *Love for Love* that Sir Joshua Reynolds painted his best portrait of her.

In 1782 she left Drury Lane for Covent Garden. After an absence from the stage from 1790 until 1797, she reappeared, quitting it finally in 1799. Her ambition, personal wit and cleverness won her a distinguished position in society, in spite of her humble origin. Women of fashion copied her frocks, and a headdress she wore was widely adopted and known as the "Abington cap." She died on March 4, 1815.

**ABINGTON,** a town of Plymouth county, Mass., U.S.A., 19 mi. S. by E. of Boston. It is served by the New York, New Haven and Hartford railroad. The population was 7,133 in 1950 and 5,708 in 1940 by the federal census. Farming, fruit growing (especially strawberries), and dairying are carried on. The principal manufactures are boots and shoes, lasts, cement blocks, window-shades and machinery. The town was settled about 1680 and incorporated in 1712.

**ABINGTON,** a township of Montgomery county in eastern Pennsylvania, with an altitude of 300 ft. It is about 5 mi. N. of Philadelphia, of which it is a suburb, and is on U.S. highway 611. Population was 28,738 in 1950, and 20,857 by the census of 1940.

It was founded in 1714, the same year in which the Abington Presbyterian church was founded. It is ruled by a mayor-council form of government, with councilmen chosen in partisan elections and the mayor selected by the governing body. The town's sewage treatment plant is publicly owned. Abington is a banking town and has its own post office and hospital. The Abington Memorial hospital was established in 1914 and is a general, short-term hospital operated as a nonprofit corporation and accredited by the American College of Surgeons.

**ABIOGENESIS,** in biology, the term, equivalent to the older terms "spontaneous generation," *Generatio aequivoca, Generatio primaria,* and more recent terms such as archegenesis and archebiosis, for the theory according to which fully formed living organisms sometimes arise from non-living matter. Aristotle explicitly taught abiogenesis, and laid it down as an observed fact that some animals spring from putrid matter, that plant-lice arise from the dew falling on plants, etc., and most of the earlier biologists accepted his views. The first step in the scientific refutation of the theory of abiogenesis was taken by the Italian Redi, who, in 1668, proved that no maggots were "bred" in meat on which flies were prevented by wire screens from laying their eggs. From the 17th century onwards it was gradually shown that, at least in the case of all the higher and organisms, abiogenesis did not occur, but that *omne vivum e vivo,* every living thing came from a pre-existing living thing.

The discovery of the microscope carried the refutation further. In 1683 A. van Leeuwenhoek discovered bacteria, and it was soon found that however carefully organic matter might be protected by screens, or by being placed in stoppered receptacles, putrefaction set in, and was invariably accompanied by the appearance of myriads of bacteria and other low organisms As knowledge of microscopic forms of life increased, so the apparent possibilities of abiogenesis increased, and it became a tempting hypothesis that whilst the higher forms of life arose only by generation from their kind, there was a perpetual abiogenetic fount by which the first steps in the evolution of living organisms continued to arise, under suitable conditions, from inorganic matter. It was due chiefly to L. Pasteur that the occurrence of abiogenesis in the microscopic world was disproved. If organic matter were first sterilized and then prevented from contamination from without, putrefaction did not occur, and the matter remained free from microbes. The nature of sterilization, and the difficulties in securing it, as well as the extreme delicacy of the manipulations necessary, made it possible for a very long time to be doubtful as to the application of the phrase *omne vivum e vivo* to the microscopic world, and there still remain a few belated supporters of abiogenesis. It may now be stated definitely that all known living organisms arise only from pre-existing living organisms. It must be noted, however, that this statement relates only to known existing organisms. It may be that in the progress of science it may yet become possible to construct living protoplasm from non-living material. The refutation of abiogenesis has no further bearing on this possibility than to make it probable that if protoplasm ultimately be formed in the laboratory, it will be by a series of stages, the earlier steps being the formation of some substance, or substances, now unknown, which are not protoplasm. Such intermediate stages may have existed in the past, and the modern refutation of abiogenesis has no application to the possibility of these having been formed from inorganic matters at some past time. Perhaps the words archebiosis, or archegenesis, should be reserved for the theory that protoplasm in the remote past has developed from non-living matter by a series of steps, and many of those, notably T. H. Huxley, who took a large share in the process of refuting contemporary abiogenesis, have stated their belief in a primordial archebiosis. (*See* BIOGENESIS; BIOLOGY.)

**ABIPONES,** a tribe of South American Indians belonging to the Guaycuruan (*q.v.*) linguistic stock. The Abipones were a warlike, nomad hunting people, living in the Argentine Chaco, between the Vermejo and Salado rivers. Although once numerous, they are now believed to be quite extinct. Both men and women wore mantles of coarse textiles, belted at the waist; the women were abundantly tattooed, the men but slightly. The latter wore long, pendant labrets. Their dwellings were tents of mats. Spears, bows, clubs, slings and bolas were their weapons. They had no shield, but used a poncho of heavy hide for protection. They made no use of canoes, having only "bull-boats" of hide stretched over a bowl-shaped frame, for crossing broad streams. Pottery was made. The people were divided into local social units, over which a semi-hereditary chief presided, although he had little power. The bodies of the dead were buried, unless death occurred far from home, when the flesh was stripped from the bones, and

these placed in a leather sack. This was carried with the roving group, until they reached their home, where it was buried. The [illegible] tent of the deceased were burned. Little is known of . beliefs and ceremonial. They possessed, however, some sort of secret societies, membership in which was attained by valour, and which celebrated ceremonials of importance.

The Abipones became widely known from the account of them written by the missionary Dobrizhofer, at the end of the 18th century, after they had become horse Indians.

*See* M. Dobrizhoffer, *An Account of the Abipones,* etc. (1822).

**ABITIBI,** lake and river, Ontario, Canada. The lake, 49° N. 80° W., 60 mi. long, is shallow and studded with islands; the shores are covered with small timber. The Hudson's Bay Co used it on a canoe route to the northern fur lands. The Grand Trunk Pacific (now the Canadian National) railway passes through this district. Its outlet is the rapid Abitibi river, which after 200 mi. joins the Moose river.

**ABJURATION,** a solemn repudiation or renunciation on oath. At common law, it signified the oath of a person who had taken sanctuary to leave the realm forever; this was abolished in the reign of James I. The *Oath of Abjuration* in English history, was a solemn disclaimer, taken by members of [illegible] and laymen against the right of the Stuarts to the [illegible] laws of William III, George I and George III; but its place has since been taken by the Oath of Allegiance.

**ABKHAZIA** (Abkhasia) (Georgian *Apkhazeti,* Abkhaz *Apsne*) A.S.S.R. under protection of Georgian S.S.R. comprising six districts of the former Sukhum province. Area 3,155 sq mi. Pop. (1939) 259,100. Its boundaries are, on the N., the North Caucasian area and Karachaev autonomous area, on the S. and E., the Georgian S.S.R.; on the W., the Black sea. It is divided into the following districts for administrative purposes; population in parentheses. Gagrinsk (9,950; urban 3,659, rural 6,291), Galsk (50,071, entirely rural), Gydaytsk (30,740; urban 3,536, rural 27,204), Kodoisk (33,043, urban 3,390, rural 29,653) and Sukhum (75,371; urban 20,032, rural 55,339). The area is mainly mountainous and densely forested (especially oak and walnut). The Black sea coastal belt from Sukhum-Kaleh southwards is an evergreen vegetation area with citrus fruits (oranges, mandarins, lemons), camellias and even palms. It has hot, sunny summers and winter rains of the western coast Mediterranean type, but in winter low-pressure systems form on the Black sea, with south and southeast [illegible] ain. Average temperature at Sukhum-Kaleh is in January [illegible] August 76.1° F. Oranges ripen in December and spring begins in February. The area is never frozen, and snow rarely falls and never lies; malaria is a perpetual scourge. The chief products are tobacco and maize, with wheat, grapes, figs, pomegranates, [illegible] and wine (vines hang from walnut trees). Tea and mulberries (for silk) are produced. On higher land, cattle and horses are bred and bees kept. The chief town is Sukhum-Kaleh on the Black sea coast (site of ancient Greek Dioskurias). Pop. 28,136. The town is noted for manufacture of saddlery. Other coastal towns are Pitsunda and Ochemchiri. There is a coastal railway. There are extensive coal deposits, practically unworked. Abkhazia, a former Georgian principality, was the home of the Abkhaz (Apkhaz) tribe (in Abkhaz *Apsua,* in Greek *Abasgoi*). A part of the Roman empire, it became Christian under Justinian (*c.* 550). In the 8th century, Leo, duke (*Eristavi*) of the Abasgi conquered western Georgia or Lazica and set up the mediaeval kingdom of Abasgia, independent of the Byzantine empire and later a part of the Georgian state (*see* Georgia). The duchy of Abkhazia itself became by 1184 a fief of the house of Sharvashidze, under which it acquired, after 1463, its independence from the Georgian crown. Ottoman suzerainty was imposed on Abkhazia in the 16th century and Mohammedanism supplanted Christianity. In 1810, George I Sharvashidze, prince of Abkhazia signed a treaty of protectorate with Russia. In 1840 the principality of Samurzaqano, under a branch of the Sharvashidzes, was annexed by Russia, and in 1864 Russia annexed Abkhazia itself. The country proclaimed its autonomy in 1919, and became an A.S.S.R. in 1921. The people are of Circassian stock, whose language belongs to the Abkhazo-Adigean group of the North Caucasian branch of the Japhetite languages. There are both tall and fair groups, and short, dark groups, with Tatar intermixture.

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**ABLATION,** the process of removing anything; a term used technically in geology of the wearing away of a rock or glacier by weathering agents, and in surgery for operative removal.

**ABLATIVE,** in grammar, a case of the noun, the fundamental sense of which is direction from; in Latin extended to the instrument or agent of an act, and the place or time at, and manner in, which a thing is done; also found in Sanskrit, Zend, Oscan, Umbrian and other languages. (Lat. *ablativus,* sc. *casus,* from *ablatum,* taken away.) The "ablative absolute," in Latin, consists of a noun in the ablative case, with a participle or qualifying word agreeing with it, not depending on any other part of the sentence, to express the time, occasion or circumstance of a fact.

**ABLUTION,** a ritual washing destined to secure that ceremonial purity which must not be confused with the physical cleanliness obtained by the use of soap and water. (Lat. *abluo,* from *abluere,* "to wash off.") Indeed the two states may conflict, as with the 4th century pilgrim who boasted that she had not washed her face for 18 years for fear of removing the baptismal chrism. In the Catholic Church the *ablution* is the ritual washing of the chalice and of the priest's fingers after celebrating mass; or the wine and water used for this purpose. The purport of ablutions is to remove the supposed stains contracted by contact with the dead, with childbirth, menstruous women, murder, almost any form of bloodshed, persons of inferior caste, dead animal refuse, leprosy, madness and disease. In general, water, cows' urine and blood of swine are the materials used in ablutions. Of these water is the commonest, and its efficacy is enhanced if it be running, and still more if a magical or sacramental virtue has been imparted to it by ritual blessing or consecration. In the *Atharva-Veda,* vii. 116, a remedy for fever is to tie to the foot of the bed a frog, bound with red and black thread, and wash down the patient so that the water of ablution falls on the frog, the magician praying that the fever may pass into the frog, which is forthwith released. In the old Athenian Anthesteria the blood of victims was poured over the unclean. A bath of bulls' blood was used as a baptism in the mysteries of Attis. The water must in ritual washings run off in order to carry away the miasma or unseen demon of disease; so the early Christians used living or running water, which the baptizer must pour over the head of the baptized person so that it runs down his body. Similarly the Brahman takes care to wipe the cathartic water off from head to feet downwards, that the malign influence may pass out through the feet. The same care is shown in ritual ablutions in the Bukovina and elsewhere.

Water, fire, spices and sulphur are used in ritual cleansings (Iamblichus on Mysteries, v. 23), as being specially full of the divine nature. But in all religions the cathartic virtue of water is enhanced by means of suitable prayers and incantations. Ablutions are usually cathartic, that is, intended to purge away evil influences (*καθαίρειν,* to make *καθαρός,* pure). But things and persons may become taboo, that is, so holy as to be dangerous and useless for daily life, through the mere infection of holiness. Thus in Syria one who touched a dove became taboo for one whole day, and if a drop of blood of the Hebrew sin-offering fell on a garment it had to be ritually washed off. It was as necessary for the Hebrew priest to wash his hands *after* handling the sacred volume as before. Christians might not enter a church to pray without first washing their hands. Tertullian (*c.* 200) condemned this as a heathen custom; but it was insisted on in later ages (Sozomen, vi. 6) and is a survival of the pagan lustrations or *περιῤῥαντήρια.* The same custom prevails among Mohammedans. Porphyry (*de Abst.* ii. 44) relates that one who touched a sacrifice meant to avert divine anger must bathe and wash his clothes in running water before returning to his city and home, and similar scruples in regard to holy objects and persons have been observed among the natives of Polynesia, New Zealand and ancient Egypt.

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**ABNAKI,** a group of closely related and confederate Algonkin Indian tribes originally centring in Maine, now mainly in Quebec and New Brunswick. The name means "east land." They included the Etchimin, Malecite, Passamaquoddy and Penobscot, often reckoned as distinct tribes. They fought the English colo-

nists, were friendly with the French, and in the 18th century most of the bands withdrew to French Canadian soil. They grew maize, hunted and fished, lived in conical houses of bark or mats, palisaded their villages, were divided into patrilineal totemic clans and were typical northern woodland tribes. Their speech is close to the Algonkin dialects of the Great Lakes. About 2,000 survive.

**ABNER.** In the Old Testament, Saul's cousin and commander in chief, comes into prominence only after the crushing defeat of Israel at Mt. Gilboa. This battle placed the Philistines in control of the whole of central Palestine, and the weakness of Israel was enhanced by the division into two parties, that of the south, which followed David, and that of Trans-Jordan, which remained faithful to Ishbaal, the son who succeeded Saul. The king himself, however, was a weak character, and the whole strength of the party was concentrated in Abner. The struggle between the two parties was continuous, and in the battle of Gibeon Abner killed Asahel, brother of Joab, thus exposing himself to the blood-vengeance of the dead man's whole family. It seems that Abner aspired to become the sole leader of his party and, as a step in the achievement of his aim, married Rizpah, one of the concubines of Saul For this he was reproved by Ishbaal, and thereupon deserted to the opposite party An agreement was made between David and Abner, by which David had restored to him Michal, daughter of Saul, thus establishing a claim on Saul's throne, and Abner was received into favour. Joab, however, in obedience to the binding law of blood-revenge, took an opportunity of putting Abner to death, and his disappearance practically brought to an end the resistance of the eastern party. David, of course, was not implicated in Abner's death, though he had no right to punish the assassin, and his short dirge over the body, like that over Saul and Jonathan, is an exquisite specimen of the early poetry of Israel. (*See* II Sam., ii, 8; iii, 39)

**ABNEY, SIR WILLIAM DE WIVELESLIE** (1843–1920). English chemist, was born at Derby, July 24, 1843, and died at Folkestone on Dec 3, 1920. Abney held high appointments at the board of education and was president at different times of the Royal Astronomical society and the Physical society. His contribution to science was mainly in the furtherance of photographic chemistry and especially of colour photography and colour printing. His publications on these subjects include *Instruction in Photography* (1870), *Colour Vision, Colour Measurement and Mixture* (1893) and *Trichromatic Theory of Colour* (1914). He also wrote *Thebes and Its Five Great Temples* (1876) and, with C. D. Cunningham, *The Pioneers of the Alps* (1888).

**ABNORMALITIES AND DEFORMITIES:** *see* MONSTER.

**ABNORMAL PSYCHOLOGY.** Psychology is the study of behaviour, and abnormal psychology is the study of deviations from normal behaviour. This definition at once raises the fundamental question: what do we mean by normal, and how are we to recognize deviations from it? The average naive person tends to consider himself as the measure of normality, and to regard as signs of abnormality all attitudes and responses in other persons that differ markedly from his own. Such a criterion, however reasonable it may seem to the individual employing it, has actually no value as a general principle. For one thing, it begins by assuming that each person is the sole judge of his own conduct, and for another, it implies that everyone is at all times normal.

An alternative to the naïve, individualistic approach is obviously that of judging each person's conduct in relation to the conduct of others in his culture who are of the same sex and belong to a similar age group To carry out this procedure we should have, ideally, a system of well-defined, established norms with which any given behaviour sample might then be compared, and its conformity with or deviation from them determined. There are, however, formidable obstacles to the construction and use of rigidly specified behaviour norms. The most serious of these are: (1) the heterogeneous composition of our contemporary industrial society, (2) the greatly increased mobility of individuals and groups, which inevitably increases the incidence of cultural conflict and (3) the relatively rapid changes in accepted standards of behaviour which have appeared within the past few generations.

These difficulties, and the existing limitations in available data and techniques in abnormal psychology, compel us for the time being to work with rough approximations, and to let the evolution of stricter definition wait upon the outcome of further exact investigation and controlled experiment. From this standpoint, the most useful criterion of normality we have is that of the relative adequacy of an individual's performance, in comparison with the behaviour to be expected of other persons sharing his status in his society. Such a criterion begins, not with the fiction of the perfect or ideal personality, but with the fact of a relatively wide range of culturally acceptable behaviour. It permits us to include as normal the many trivial oddities and irregularities, the little unexpected and unpredicted developments that can be found in the everyday reactions of ordinary persons.

**Relationship between Normal and Abnormal.**—From ancient times down to the present there have been two diametrically opposed views with regard to this important problem According to one, there is a clean break, a chasm, between normal and abnormal The normal person, it is contended, cannot possibly put himself in the place of abnormal persons and see things from their perspectives According to the other view, there is unbroken continuity between normal and abnormal (principle of continuity). That is, the normal shades imperceptibly into the abnormal, and both share a borderland in which normality and abnormality cannot with certainty be distinguished.

The absolutist tradition, which sharply divides abnormal from normal behaviour, finds popular expression in such statements as that a person is out of his head, has lost his reason or his mind, and therefore needs an alienist; *i.e.*, a specialist who deals with the mentally estranged. Most 19th-century alienists and nerve specialists, the predecessors of modern psychiatrists accepted this hypothesis of discontinuity as fact They tried to give substance to their speculations by postulating hypothetical brain and nerve changes in their patients to parallel the behaviour deviations which they observed. Early in the 20th century it was demonstrated conclusively that general paresis is the result of a specific brain infection. This raised the hope among absolutists that some day all neuroses and psychoses might prove to be no more than diseases of the brain. Their hope during the intervening four decades failed to materialize Indeed, as data have accumulated concerning general paresis itself, the conclusion has been reached in recent years that whatever behaviour disorder develops in general paresis depends for its character, not upon the specific infection, but upon the preparetic personality traits of the individual patient.

The relativist tradition, which maintains that there is continuity between normal and abnormal behaviour, did not become dominant in behaviour pathology until the 20th century. The position of the relativists was greatly strengthened by the growing realization, late in the 18th century and throughout the 19th, that abnormal phenomena could be deliberately induced for a short time in normal persons. Credit for arousing widespread interest in this fact belongs to Friedrich Anton Mesmer, the great hypnotist, who reached the height of his fame toward the end of the 18th century. It was his work that stimulated later investigators to make use of hypnosis therapeutically; and it was this therapeutic use which, in the latter half of the 19th century, led to the historically crucial feud between Parisian physicians, led by Jean Charcot, and Nancy physicians, led by Hippolyte Bernheim and Ambroise-Auguste Liébault.

**Rise of Modern Behaviour Pathology.**—The Paris-Nancy feud arose over differences concerning the relationship between hypnosis and hysteria. The Parisian group maintained that only the potentially hysterical could be hypnotized successfully; the Nancy group insisted that anyone could be. Each side was partly right, since we now know that nearly every adult

can be hypnotized and that most hysterical symptoms can be hypnotically induced in normal persons However, by far the most important outcome of the celebrated quarrel was a greatly increased interest in the origins and characteristics of psychopathology, or behaviour pathology. Two of the men who came directly under Charcot's influence during the last quarter of the 19th century became themselves internationally famous as behaviour pathologists Pierre Janet, who ultimately succeeded Charcot at Paris, began his long series of contributions to abnormal psychology with the publication of *L'Automatisme psychologique* in 1889 and *L'Etat mental des hystériques* in 1893. Sigmund Freud was a contemporary of Janet in Charcot's clinic during 1885; but he also visited Bernheim in Nancy for a few months in 1889. He translated the writings of both Charcot and Bernheim into German Freud's first papers on behaviour pathology, published in 1893 and 1895, were on the mechanisms of hysteria and show the effects of these early contacts.

No one else in recent times has influenced the development of abnormal psychology as profoundly as has Sigmund Freud Those who attack him on methodological grounds are likely to find themselves corroborating, through the use of their more sophisticated procedures, some of the fundamental tenets which Freud succeeded in deriving from simple observation Those who reject his hypotheses because they are phrased in the language of 19th-century psychosomatic dualism, discover that his most important constructs can be reformulated in modern biosocial terms without losing in usefulness. Indeed, one of the principal tasks confronting abnormal psychology in the mid-20th century was that of following up the leads indicated by the pioneer work of Freud and the psychoanalysts, with the aid of modern techniques and modern hypotheses.

## NEED AND SATISFACTION

The deviations with which abnormal psychology deals are often referred to as personality disorders. They are primarily disturbances in an individual's acquired systems of behaviour which define his social personality and upon which his interpersonal relationships depend. Consequently, in all discussions of behaviour pathology the social and cultural aspects of human living receive strong emphasis This does not mean, however, that we can neglect the biological aspects. Personality and its abnormal developments must always be studied as the products of a lifetime of interaction between a human organism and the environment by means of which it lives. It is through this interaction that each person learns to satisfy biological needs within the framework supplied by the social organization around him; and it is through the same interaction that each of us acquires innumerable new biosocial needs and satisfactions

By need we mean a condition of unstable or disturbed equilibrium in an organism's behaviour. This appears typically in the form of increased or protracted activity and tension. Need is characteristic of all ongoing activity sequences, whether these are overt or covert. It may result directly from some alteration in the relationship between organism and environment, as in sharp changes of temperature, or as the direct outcome of metabolic processes within the organism itself, as in hunger and thirst. In human beings, need commonly arises also as the more indirect result of symbolic behaviour, such as talking, reading or thinking.

The termination of need we call satisfaction. When this results directly from the increased activity incident to a need, as when eating or drinking restores the hungry organism's equilibrium, we speak of direct satisfaction. When a specific need is terminated through a mere shift in activity, through the distraction furnished by new stimulation, or by means of some learned substitution, we speak of indirect or substitute satisfaction. Under the conditions of human group living, with its compromises, its arbitrary rules and its cultural traditions, the indirect or substitute satisfactions take on great significance, and particularly so in the development and persistence of ab-

Unsatisfied need is an important factor in behaviour from the moment of birth. To be born is to be separated from the automatic machinery of satisfaction which life in the mother's uterus provides, and to be left for the first time dependent upon the convenience and good will of someone else. The newborn infant is thus introduced to his first frustrations in the form of delay between the appearance of need and its satisfaction It is largely through his dependence upon older persons that the human infant and child is gradually inducted into the customs of the society into which he is born. His parents or parent-substitutes originally control all the means of a small child's satisfactions; and they relinquish control only as the child shows the ability to conform to social regulations in his patterns of need and satisfaction In other words, the human being's inability early in life to satisfy his needs unaided constitutes one of the most important conditions for his progressive socialization.

The child receives his earliest lessons in distinguishing right from wrong when he learns the simple regulations which his society has set up in relation to eating, drinking and elimination, to body care and cleanliness and the taboos against erotic interest These early acquired distinctions between that which his elders reward, as right, and that which they punish, as wrong, have been called visceral ethics; *i.e.*, ethical attitudes derived from learning the social control of visceral functions. Chiefly through the influence of psychoanalytic schools of thought, modern behaviour pathology has come to place considerable emphasis upon the importance of visceral ethics. This emphasis, in turn, has thrown much light upon the striking confusions that one encounters clinically between goodness or badness and questions of food or fluid intake, elimination, sex functions, cleanliness and body care Some of the more common confusions of this kind are to be found in compulsive handwashing, in hypochondriacal attitudes toward gastrointestinal functions, in complaints of impotence and frigidity based upon guilt and aversion, in hysterical loss of appetite and in delusions of body change

**Hunger and Thirst.**—As simple biological needs, which require no more than food and fluid intake for their satisfaction, hunger and thirst are seldom significant in abnormal psychology. However, in western society the normal satisfaction of hunger and thirst takes place under conditions that inevitably lead to important interpersonal relationships. Infant and child feeding, for example, involves intimate contact and personal interaction between mother and offspring. In this relationship are laid down some of the most fundamental patterns of social acceptance, approval and affection Throughout childhood and adolescence, feeding continues to be an effective means of socialization. Banishment from the family table and the withholding of food are common types of punishment for nonconformity. Extra helpings and special foods are frequently used as rewards for pleasing behaviour or as consolation for other losses and for sacrifices. Moreover, the relationship of eating to health, strength, growth, good looks and biological maturing is repeatedly pointed out to child and adolescent at the family table.

If we are to understand some of the remarkable confusions met with in behaviour pathology, it is essential to realize that eating and drinking are by no means confined to the satisfaction of hunger and thirst, or even to social acceptance and approval within the family circle. We normally eat and drink in celebrating success, in sealing agreements, in mourning our sins or our losses through death, in solemnizing our hopes and in signifying unity with the divine. It must also be remembered that the mouth is used for many activities other than feeding. Infants and young children employ it as an organ of examination, manipulation and attack, just as subhuman mammals do. Older children and adults use it for kissing and, in an infinite variety of situations, as an organ of speech, grimace and oral gesture.

To all these potential sources of confusion must be added the influence upon a person of common metaphors, of fairy tales, folklore and superstition. Eating and drinking are related in stories, for example, to sudden body growth and shrinkage, to

miraculous changes in strength and beauty, to magical powers and magical helplessness, to fertility and impregnation and to the transformation of men into animals or gods. Thus, when a person becomes acutely anxious, insecure or disoriented, it should not surprise observers if he shows a disorganized intermingling of these different meanings, and tries to translate abstract symbols inappropriately into concrete action.

**Sex Need and Satisfaction.**—Early in the 20th century, Freud and his followers attached the greatest significance to sex in relation to behaviour pathology. The work of subsequent investigators, both psychoanalytic and nonpsychoanalytic, has in large measure verified this judgment Certain peculiarities of sex functions help to account for their pre-eminence. The direct satisfaction of sex need, for example, unlike the situation in hunger and thirst, can be delayed for long periods and even permanently denied without resulting in death. Accordingly, sex activities can be regulated and restrained to a degree that is not possible in the case of hunger and thirst Furthermore, although from infancy onward direct and indirect erotic stimulation can occur, full heterosexual satisfaction is biologically impossible for several years, while for several years more it is socially prohibited.

It is under precisely such conditions of intermittently occurring delay, thwarting and conflict that substitutive tension-reducing patterns of behaviour are acquired (*see* DEFENSE MECHANISMS) To the extent that these learned substitutive reactions lead to maladaptive results, they are likely to become implicated in the development of neuroses and psychoses. Of course, there are more cogent reasons for the social control of sexual satisfaction than the mere fact that control is biologically feasible. Mature sex behaviour involves two persons in a reciprocal relationship; and the one upon whom the biological burdens of pregnancy and childbirth fall is also the weaker of the two. Moreover, sex satisfaction is unique in leading to the production of new members of the social community, and the community therefore assumes the right to regulate the preliminaries of procreation and parenthood. Man shares with other mammals a further tendency to develop aggressive, jealous and vengeful attitudes with respect to courtship and mating Such a tendency demands that, for the sake of peace and security in the community, both rights and responsibilities be assigned to persons entering into these relationships.

In contemporary western society the taboo against sexual activities in childhood is usually extended to include taboo against their discussion. This is undoubtedly an important source of the sex confusions so commonly encountered in behaviour pathology. We know that attitudes become socially mature either through shared activities or through the interchange of perspectives that can develop in free discussion, particularly discussion with a socially mature person. Unfortunately, in matters of sex the average person has not himself enjoyed in childhood the benefit of frank discussions with a judicious, informed adult. Consequently, he is seldom equipped to help his own child acquire social maturity in this important area of human interest. He is easily embarrassed and made anxious by his child's sex curiosity and is therefore more likely to silence or reprimand his questioner than to meet each situation as it arises with mature effectiveness. The result is that the next generation grows up as little matured in sex attitudes as the last one.

During pubescence and adolescence there occurs a marked acceleration of biosocial maturing. This is in part the direct result of biological changes, in part the more indirect consequence of concomitant increases in social pressure. Sex problems, which in childhood were controlled by simple permissive and inhibitory training, now reappear with new vigour in a new social context. Instead of merely showing sex curiosity, the adolescent begins attempting seriously to interpret and play the role of his sex in terms of his peer culture. Adolescence thus becomes the phase of development during which ease and skill may be acquired in social behaviour with contemporaries of the opposite sex, an acquisition which aids in the general process of emancipation from filial dependence and prepares one for adult love relationships.

Under the influence of the social environment, sex needs and satisfactions undergo many significant modifications by the time adulthood is reached. It is expected that sex attitudes will be oriented toward marriage and family formation; and they cannot receive social recognition unless they conform to civil or religious codes Marriage, the family and the home are in turn made the basis of socioeconomic organization. In this way, sex attitudes and responses are brought into direct behavioural relationship with social and economic problems, with ethical standards of all kinds, with religious beliefs and practices, as well as with questions of hunger, thirst, warmth, shelter, security, approval and personal significance. Here we see how the groundwork is laid, in the domestic organization of life, for the unification of otherwise unrelated needs and satisfactions The same domestic organization leads also to the intricate confusions we find in behaviour pathology between sex conflicts and economic, social, religious and ethical questions.

**Primary and Derived Needs.**—The needs discussed above constitute only a fraction of those which are pertinent to abnormal psychology; they are, however, representative and they are unquestionably important. In relation to these and other needs, the attempt is sometimes made to distinguish between those which are primary and those which are derived. The primary needs are usually defined as the purely biological ones, while the secondary or derived needs are defined as the ones modified by the social environment or developed out of some nonbiological relationship. In practice, however, this distinction cannot be maintained None of the so-called biological needs fails to undergo far-reaching socialization, beginning early in life, and none of the so-called secondary or derived needs can ever be completely divorced from the human organism's physiological activities. Actually, all needs of significance to abnormal psychology are in this sense derived. they represent the disequilibrium of a biological organism which operates always in terms of its social environment.

## FRUSTRATION AND CONFLICT

**Frustration.**—By frustration we mean a situation in which ongoing motivated behaviour, or some organized plan of action, is permanently or temporarily prevented from reaching consummation. During all phases of the development, maturity and involution of personality, everyone must inevitably meet with repeated frustration. Need arises and there is delay, thwarting or conflict before it can be terminated and satisfaction reached. Each of us in his childhood acquires special adjustive techniques which enable him to circumvent, overcome, evade, nullify or disown the innumerable difficulties which can be solved neither by direct aggression nor by headlong flight (*see* DEFENSE MECHANISMS). Individuals show marked differences in the degree to which they develop these adjustive techniques, or defense mechanisms, in their preference for one defense over another, and in the degree of frustration they can withstand (*frustration tolerance*) before their preferred techniques prove inadequate, or operate to their own detriment.

During early infancy, of course, the commonest form of frustration is delay. The infant's inadequate biological equipment does not permit him to satisfy his needs without an older person's help. Delay continues to be an effective condition of frustration throughout life. As the growing child acquires greater strength and more aggressive techniques, he gains increasing familiarity with thwarting, a second form of frustration. His small size, his relative weakness and incompetence, and the obstacles which are intentionally or unintentionally placed between him and his goals, all contribute to [illegible] When he acquires speech and his thinking undergoes progressive socialization his needs multiply; and to the [illegible] obstacles that thwart him are now added symbolic obstructions such as verbal warnings, signs, rules and his own self-reactions. As he grows into adolescence and adulthood, his level of aspiration is raised in a great many relations, so that he never succeeds in reaching all his goals, no matter what his ability.

**Conflict.**—The third important form of frustration is conflict, by which we mean the mutual interference between competing reactions. This interference prevents ongoing motivated behaviour from developing adequately and reaching a consummatory phase. The competing reactions may be overt or covert, they may be confined to antagonistic changes in muscular tension, or they may be conceived of as mere shifts in action potential

Conflicts have been grouped into three classes adient-avoidant, double-adient and double-avoidant The adient-avoidant conflict involves two incompatible reactions, one directed toward and one away from an object, activity or goal What we call guilt is an adient-avoidant conflict in which temptation is the adient reaction, while the avoidant reaction is the partial inhibition which prevents consummation of the act but does not terminate it The sustained anxiety that develops in such conflict may eventually lead over into an anxiety disorder, phobia, compulsive or hysterical disorder. It is also responsible for many delusional and hallucinatory reactions in paranoid disorders, mania, depressions, schizophrenia and deliria.

Double-adient conflicts are of two kinds. In convergent adience only one object, activity or goal is involved, but the person gives two incompatible reactions toward it. Sibling rivalry, for example, typically includes simultaneously present hostile aggressive and affectionate accepting attitudes. In divergent adience there are two objects, activities or goals, and competing reactions toward both develop This conflict is characteristic of situations which promise a person a reward he wants on condition that he abandon something else he also wants Attempted solutions of divergent adience sometimes take the form of the enjoyment of one satisfaction in the public shared field of overt activity, and of the other satisfaction in private asocial fantasy. This is a common source of behaviour pathology.

The double-avoidant conflict involves two incompatible reactions, each directed away from some object, activity or goal This is characteristic of situations which threaten to harm a person if he remains and to punish him if he leaves, as for example in military combat situations It also appears where there is intense boredom, aversion or humiliation in the situation but the expectations of other persons, or the prospect of starvation, prevent one from abandoning it. Hysterical and depressive disorders are common pathological solutions of the double-avoidant conflict.

Although a great many conflicts disappear with time and distraction, or in the course of simple training, a great many more are not so easily resolved as this. Some of the latter are settled through compromise or substitution. In sibling rivalry, for example, the older child may substitute taunts, belittling comments and nonco-operation for the direct blows he would give his baby brother if he could. He may, on the other hand, overcompensate in denying his hostility and react instead with exaggerated solicitude toward his rival. He may attempt to escape his predicament by the radical expedient of running away from home, thus leaving the conflict field entirely. This last solution occurs among adults in hysterical fugues; the individual in conflict runs away from it and develops amnesia which hides his identity even from himself.

To settle a conflict does not guarantee that it will never return. If situations similar to the ones originally arousing it appear, the old conflict like an old remembrance may be reinstated. However, it is the incompletely resolved conflict that is most likely to keep recurring, and therefore to form a starting point for neurosis or psychosis. The recurrent conflict means recurrent tension, difficulty in relaxing or sleeping adequately, unreadiness for diversion and entertainment and an inability to achieve satisfaction for personally important needs. It may lead directly into chronic anxiety reactions, phobias or depressive disorders Some persons with perpetually recurring conflict develop compulsive rituals, hysterical disabilities or manic attacks as a defense against their anxiety. Others escape it by developing body overconcern, fatigue syndromes or schizophrenic withdrawal, which provides relief from anxiety but seriously impairs the individual's social usefulness.

**Conscious and Unconscious Conflicts.**—A conscious conflict is one that can be correctly identified or inferred by the person in conflict. An unconscious conflict is one that someone else can correctly identify or infer, but the person having it cannot There are, of course all gradations in accessibility between these two extremes Theorists in abnormal psychology have in the past gone beyond this simple distinction to [illegible] unconscious conflicts are radically different entities from conscious ones, and have located them in a hypothetical psychic region which they designate the unconscious Actually there is no need to introduce the hypothesis of a special, unconscious reality to account for the differences that we find in the relative accessibility of conflicts

We may begin with the observed fact that conflicts do vary in the degree to which they are accessible to the reactions of the individual having them Conscious conflicts are those which are fully accessible to a person's self-reactions; *i.e.*, to his reactions toward his own behaviour A person may share the fact of his conscious conflict with someone else or he may keep it to himself as a secret; but in either case the important thing is that he is able to formulate it to someone, to himself or to another individual If he keeps the conscious conflict to himself, of course, he can still debate it aloud in solitude, like Hamlet, or go over it silently in his socially organized thinking. The conscious or fully accessible conflict is frequently a source of behaviour pathology To identify or infer one's difficulties correctly is not to guarantee that they will miraculously disappear; if compromise, renunciation or escape cannot be carried through successfully, the situation may become just as intolerable as in the case of unconscious conflict.

However, in abnormal psychology it is the conflict which remains relatively inaccessible to a person's self-reactions, the unconscious conflict, that is by far the more important. To understand its origins, its consequences and the therapeutic techniques that have been developed to cope with it, is to understand the greater part of modern behaviour pathology. There are innumerable reasons for the inaccessibility of conflicts. Five of the simpler and more general factors will be listed here.

1. Conflicts become and remain inaccessible to a person (unconscious) because of previous threat or punishment. Early in life the threat or punishment comes from other persons, but as time goes on, a person learns to threaten, criticize, reject and punish himself. Moreover, the anxiety which threat and the prospect of punishment arouse is likely to generalize to situations not originally involved and not necessarily related in terms of strict verbal logic. Simple juxtaposition and concomitance, for example, are sufficient conditions for the development of new anxieties out of an old conflict.

2. Conflicts remain inaccessible (unconscious) if a person has never succeeded in formulating them. Language and socially organized thinking are of the utmost importance in the recall of any complex behaviour and in its analysis. Therefore, as long as a conflict remains unformulated in these terms it can rarely be adequately recalled and correctly identified as an effective factor.

3. Conflicts remain inaccessible (unconscious) because of strong emotional participation. When emotional components of behaviour are dominant in a conflict situation they may disorganize behaviour, at the time, or later on when recall is attempted. The recall of strongly emotional situations is also made difficult by the fact that it is seldom possible to reinstate the emotional components in their original intensity, or even with their original characteristics The therapeutic methods of recumbent free verbalization ("free association") are designed to facilitate the recall and the reliving of past incidents with something approaching their original intensity and character.

4. Conflicts remain inaccessible (unconscious) because a person cannot recall his fantasies. This difficulty is in part a result of the relatively loose organization of fantasy as contrasted, for example, with communicative speech. It is also frequently a result of repression (*see* DEFENSE MECHANISMS) Thus, anyone who is suddenly interrupted by someone in the midst of his fantasying may find himself incapable of remembering anything he has been thinking. We see this repeatedly in treatment situations where a neurotic patient, for example, will likewise show an inability to recall his own fantasy, and this inaccessibility frequently resists therapeutic attack for a long time.

5. Conflicts remain inaccessible (unconscious) because a person fails to recognize and accept the significant factors involved The average individual, no matter how intelligent or well-educated he may be. has neither the detachment nor the special training required for the successful analysis of his behaviour when he is in trouble. Sometimes, in relatively uncomplicated conflicts, it is possible for an expert to identify and explain significant factors in such a way that the patient can recognize and accept a correct interpretation with lasting benefit. Usually, however, the person in serious conflict cannot assimilate a ready-made interpretation. but must instead work out the significant factors himself with an expert's impartial help, even though this takes much longer and leads ultimately to essentially the same conclusions which the expert had come to early in the process

**Conscious and Unconscious Motivation.**—One of the basic assumptions in abnormal psychology is that all organized reactions are motivated. This simply means that the analysis of behaviour, if carried far enough, would always yield identifiable factors of special significance in the instigation, determination and sustaining of all organized acts. Such factors we call motives. The motive is thus not some form of hidden energy, a force, a drive or a first cause, as sometimes implied in popular writings. It is merely a verbal designation which is itself the product of our own operations in the motivational analysis of human behaviour

The unconscious motive is not to be thought of as something which lurks dangerously in a psychic underworld. The distinction between conscious and unconscious motivation, like that between conscious and unconscious conflict, rests upon the question of whether or not the motive is accessible to the individual concerned. If a person can correctly identify or infer his motivation, we speak of it as conscious; if he cannot, but someone else can, we call it unconscious. Some of the special characteristics ascribed to unconscious motivation undoubtedly result from the fact that what is inaccessible to a [illegible] escapes a great many of the socializing influences by which other behaviour is modified.

## INDIVIDUAL SUSCEPTIBILITY TO BEHAVIOUR DISORDERS

Sex differences, physiological age and relative biological competence may all enter into the determination of behaviour pathology in any given individual. However, when it comes to individual differences in susceptibility to behaviour disorders, the most important factors seem to be the differences in frustration tolerance, and in the development and use of special adjustive techniques, or defense mechanisms The wide variations in frustration tolerance, mentioned earlier, are to be found not only in comparisons of one individual with others, but also in comparisons of the same person's tolerance level at different times and under varying conditions of stress. Moreover, one person may exhibit low general frustration tolerance (*i.e.*, he reacts maladaptively to any ordinary frustration) while another may exhibit low specific frustration tolerance (*i.e.*, he reacts maladaptively to some particular group of frustrating circumstances but not to others). This multiple variability in resistance to frustration helps to account for the great range we find in both the intensity and the variety of precipitating factors in neuroses and psychoses.

Similar observations may be made concerning the development and use of special adjustive techniques or defense mechanisms. The failure to develop adequate defense reactions, for example, leaves one vulnerable in a crisis to mounting anxiety; and this may culminate in frank anxiety attacks, phobia or agitated depression. The overdevelopment and unskilled or injudicious use of defense reactions, such as rationalization and projection, often lead in the direction of delusional and hallucinatory behaviour. Likewise, regressive techniques may render an individual susceptible to hysterical disorders fatigue syndromes or hypochondriacal invalidism. Excessive fantasy favours a gradual withdrawal from participative activities; and this may in turn permit desocialization to develop and progress to a point at which the social disorganization of a person's behaviour justifies our calling it schizophrenia. Thus, we have also multiple variability in the maldevelopment and misuse of defense mechanisms to help explain the variation in degree and kind of susceptibility to behaviour pathology

**Childhood Influences.**—Individual differences in frustration tolerance and in the adequacy of adjustive techniques can be ascribed chiefly to differences in what is acquired in the course of childhood personality development. One of the most important factors influencing this development is that of the prevailing domestic pattern If the otherwise healthy child of a chronically fatigued or overanxious parent begins to exhibit habitual fatigue or exaggerated anxiety, the public is apt to blame biological inheritance. The child is said to be "delicate, like his mother," or "nervous, like his father." Actually, of course, these are examples of contact transmission, not biological inheritance, since teachers, playmates or neighbourhood invalids can have the same influence In short, children learn to adopt the attitudes and techniques prevalent among their elders or associates, whether these include abnormal reactions or not. If abnormal behaviour is acquired in childhood, and subsequently abandoned for something better, it may still leave an individual more susceptible than the average person to its reappearance, later in life, when new difficulties arise

Differences in the prevailing patterns in different homes help also to account for many of the variations we find, from person to person, in the kinds of behaviour pathology which develop under comparable conditions of stress—the so-called "choice of neurosis." If a chronically insecure parent meets his anxieties habitually by the use of compulsive ritual, this preferred technique may be adopted by the child. If the home environment is dominated by elders with chronic body overconcern, a child may grow up in it with hypochondriacal reaction-sensitivity to normal physiological functions. If a child is reared among adults or older siblings who show pathological fear of lightning, high places, sin, darkness, animals or contamination, he will be likely to acquire phobias himself, and to react later in life with these patterns of behaviour pathology rather than with others.

Children who are not given a maladaptive pattern of behaviour to adopt can, instead, be trained in one by their elders. An oversolicitous parent, with no serious doubts concerning his own body functions, may by worrying aloud over his child's minor discomforts, transient sickness or normal fatigue, unintentionally school the child in worrying over himself. Such a child learns to react to himself as his elder reacts to him, to interpret normal physiological events as signs of danger, and to develop a lack of confidence in his own health and strength. If he is given the privileged status of a sickly or delicate person because of his complaints, he may learn to utilize them to gain rewards, to avoid unpleasant tasks and to excuse failure. Likewise, the child whose parents are more overprotective than anxious, may nevertheless be trained in anxiety through the incessant warning, guarding, restraint and taboo with which he is surrounded. By learning to look always for danger before attempting anything, he develops a habitual expectation of danger and is thus rendered chronically insecure because of his selectively trained imagination.

Domineering parents sometimes control a child by keeping him continually dependent upon their emotional support and always uncertain of it. They give affection only as a reward for complete submission, and they withhold it the moment filial rebellion threatens to appear. The child trained in submission is an emotionally dependent child who is unlikely to develop adequate emotional independence in adolescence and become a socially mature adult. In business, professional, domestic and friendship relations, the adult with such a childhood is apt to expect special consideration and privilege from others, in return for dependent behaviour, and to misinterpret ordinary adult competition and detachment as hostility and rejection. The outcome may then be an abandonment of adult goals, with the substitution of less mature ones, or the elaboration of misinterpretations into delusional structures.

The child made oversensitive to guilt becomes especially vulnerable to behaviour disorder in adolescence and adulthood. Every child learns anxiety in relation to anticipated punishment, and when he is tempted to do something for which he has been previously punished or threatened, his anticipatory anxiety tends

to reappear. As they grow older, children learn also to use the words and attitudes of condemnation or threat toward their own behaviour (self-reactions) through which older persons had earlier controlled them These self-reactions are capable of arousing severe anxiety over one's own thinking, intending or doing forbidden things, and they are much more difficult to escape than the criticisms of other persons Under sufficient stress such conflict situations, for the individual overtrained in guilt reactions, may lead to the development of anxiety disorders, compulsive penitential or protective rituals, agitated depression, manic attacks or schizophrenic disorganization.

**Illness, Injury and Defeat.**—At any period of life, behaviour pathology may develop out of the circumstances incident to illness or injury. The sick and the injured are relatively helpless and dependent They commonly suffer pain, weakness, discomfort and disability which may form a basis for body overconcern, easy fatigability, chronic anxiety reactions or hysterical disorder. If patients are overtrained in watching over their physiological functions during convalescence, they may be unable to abandon this acquired solicitude when it becomes unnecessary and inappropriate. Moreover, the sick and disabled are granted special rights and exemptions which they lose as soon as they are well again. This leads sometimes to an indefinite prolongation of convalescence which, of course, is usually unplanned and unrecognized by the patient. Thus, chronic invalidism may follow upon illness or injury and lead to permanent hypochondriacal, fatigue or hysterical disorders.

Severe disappointment, disillusionment and defeat may also increase an individual's susceptibility to behaviour pathology at any age. The biosocial conditions of middle and late life, however, are especially apt to provide these factors The middle-aged or elderly person finds his general energy level diminishing, begins to realize the impossibility of ever reaching his hoped-for goals and sees himself gradually overtaken and then outdistanced or displaced by a younger generation. Like-aged relatives and friends in increasing number sicken and die, while the opportunities for acquiring new friends steadily decrease.

Many of the reactions to aging, for which explanations were once sought exclusively in brain pathology, are now recognized as the maladaptive behaviour of a person whose security and satisfactions have been undermined by biological waning and social restriction. In other words, the difference between normal and pathological senility cannot be completely expressed in terms of relative brain degeneration. It is also determined by the degree of stress or frustration to which the individual is subjected, his habitual reactions to it, his adaptability to change, and the consequences to him of the reduced social status that comes with increasing age.

## BEHAVIOUR DISORDERS

The behaviour disorders are relatively fixed, crystallized patterns of maladaptation. They have been divided traditionally into neuroses and psychoses. This division was originally based upon an erroneous hypothesis which attributed neuroses to nerve damage and psychoses to impairment of the psyche or the brain. The distinction is still preserved as a convenience in differentiating between disorders which justify legal commitment to a psychiatric hospital and those which do not. Freud attempted to divide neuroses further into those resulting from actual nerve disorder (actual neuroses) and those which he believed to be psychic (psychoneuroses). Although the concept of actual neuroses has proved to be unfounded, Freud's term psychoneurosis is used today to mean the same as neurosis.

Behaviour disorders are exceedingly difficult to classify. They cannot be grouped in accordance with aetiological agents, as infectious diseases can, because different individuals react to similar stresses in radically different ways. They cannot be grouped according to structural defects or lesions, since in the behaviour disorders none can be consistently demonstrated Consequently, they are classified in terms of behaviour pathology which means, of course, that all the difficulties inherent in classifying behaviour are carried over into abnormal psychology.

There were several official classifications in use at mid-20th century, each of which disagreed in some particulars with the others and possessed certain advantages in the eyes of its users. The three most widely employed in English-speaking countries were those sponsored, respectively, by the Royal Medico-Psychological association, the American Psychiatric association and the United States army The classification adopted, in the discussion which follows, is derived from these sources. It recognizes eight major disorders, of which the first five are customarily designated as neuroses (hypochondriacal disorders, fatigue syndromes, anxiety disorders, compulsive disorders and hysterical disorders), while the remaining three are the psychoses (paranoid, schizophrenic and manic-depressive disorders). In accordance with the United States army procedure, the organic psychoses are not included as a separate group. They will be discussed under *Cerebral Incompetence* at the end of this article.

**Hypochondriacal Disorders.**—The hypochondriacal person is habitually preoccupied with a supposed disease or defect in some part of his body which is functioning within normal limits; or he is exaggeratedly concerned over an actual disease or defect. Most hypochondriacs diagnose their own ills, and prescribe for and treat themselves; a great many consult physicians at least once or twice, and a minority do so chronically. In the United States, Great Britain and the dominions, millions are spent annually on patent medicines, tonics, laxatives, liver and kidney pills, antacids and the like, by persons whose illness lies not in the part they are treating but in their adaptation to the life they live. Since body overconcern is by no means confined to the well-to-do, the financial drain from this huge, unnecessary expenditure creates a serious socioeconomic problem. Even more serious, however, is the loss in a person's social effectiveness which constant preoccupation with body complaints inevitably entails.

It is not difficult to understand the origins of hypochondriacal disorders. Everyone is taught in childhood to observe his body functions, to comment upon them, to take pride in healthy performance and share his elders' concern over anything that goes wrong. If this training is too thorough, a child will become reaction-sensitive to some of the many normal activities of his body, and learn to watch and worry over them. Such an individual, when exposed later in life to prolonged anxiety or unsatisfied need, is likely to react with his already established patterns of body overconcern. As one might expect, gastrointestinal complaints head the list in hypochondria, even though fatal disease is actually much commoner in the cardiovascular system. Food intake, digestion and elimination are, after all, readily accessible to observation, discussion and control; and the vast amount of information and folklore available to the public focuses the attention of anxious and dissatisfied persons upon them.

**Fatigue Syndromes.**—In this group the patient speaks of continual fatigue and easy fatigability, in the absence of systemic disease or defect sufficient to account for them. A person with these complaints tends to avoid activities, situations and responsibilities that seem to induce or increase fatigue, and in consequence suffers a severe reduction in social effectiveness and in the opportunities left him for enjoyment. Some patients eventually lead a hermit's existence, shut away from all but a handful of friends whom they seldom see, and restricted to a routine which provides minimal disturbing stimulation.

Factors predisposing a person to develop pathological fatigue include childhood training in regarding oneself as weak or delicate, the example set in childhood by chronically fatigued adults and personal experience at any time of life with prolonged illness and convalescence. Under such conditions the individual may learn to react selectively to normal physiological events as if they were danger signals that he is overtaxing his strength. Fatigue in this sense is not an energy concept, but rather an attitude of aversion or unreadiness with respect to new or continued activity. It may result from overwork and inadequate rest, but it may equally well come from prolonged anxiety, frustration, disappointment or discouragement. This helps to explain the failure of rest and recreation to bring about a lasting improvement in persons suffering from pathological fatigue.

Fatigue syndromes, under the name of neurasthenia and nervous exhaustion were once called the American disease, and attributed to the strain of protracted conflict. The conflict was supposed to be that between the demands made by a ruthless, competitive mode of life and the ethical standards carried over from the more stable European culture. It was further believed that this situation depleted the supply of essential biochemical substances in the patient's nerves with consequent weakening of the nervous system. These hypotheses gave rise to the rest cure, the goal of which was to restore the nerves to their normal condition by overfeeding and complete inactivity. With the rise of modern behaviour pathology, both the rest cure and the hypotheses that gave it birth have been discarded.

**Anxiety Disorders.**—The prevalence of anxiety disorders is an expression of the fact that, although human beings are continually exposed to emotional stimulation, under the conditions of group living, they have relatively few opportunities for complete emotional reaction. They are frightened but cannot flee or hide, they are angered but cannot attack, they are sexually stimulated but cannot directly respond. Anxiety is the incomplete or amputated emotional response which appears under circumstances such as these.

If anxiety becomes persistent, and disturbs the pattern of a person's life, we speak of chronic anxiety disorder. The pathologically anxious person cannot relax, he sleeps poorly, has uneasy or frightening dreams and responds exaggeratedly or inappropriately on slight provocation. Because of his tension, he grows fatigued, irritable and dissatisfied, he cannot concentrate or remember as he once could and he usually develops visceral symptoms which reflect his emotional disturbance. He may have acute anxiety attacks, at irregular intervals, in which his heart palpitates, he sweats, his breathing grows laboured and he may think he is about to die; these attacks are frequently mistaken for signs of heart disease. Anxiety attacks in some persons take the form of acute gastrointestinal dysfunction, and in others resemble asthma.

Regardless of the precise symptomatology in anxiety disorders, the striking thing is that the patient rarely attributes his symptoms to their origin in the biosocial stresses and strains arising out of his personal and social problems. If he fails to get competent help, his next step is to avoid the situations which seem to arouse or increase anxiety, and to blame these situations for his predicament. Like the hypochondriacal and fatigued patients, he progressively limits his activities and his pleasures, and like them he decreases his general adequacy without gaining permanent relief. For no matter how many situations he avoids, he cannot escape the tensions of his own unrecognized needs and conflicts.

Phobia, or pathological fear, is an anxiety disorder in which the patient is able to identify the anxiety excitant, but cannot explain it. The commonest excitants of phobias are small, enclosed places, large wide-open spaces, public gatherings in or out of doors, high places, the dark, animals, germs and poisons. Actually, the situation or object which the patient accuses is as a rule some fragment, substitute or symbol of something which he has forgotten, repressed or never identified. It may have been part of a conflict which the patient has succeeded in partially repressing, without getting rid of his anxiety reaction to the partial rearousal. Treatment in phobias, as in other anxiety disorders, is directed not at the symptom but at its origins and what it represents.

**Compulsive Disorders.**—These are ritualistic attempts at dealing with anxiety. The compulsive reaction consists of an irrepressible tendency to think, say or do some particular thing which is opposed by a simultaneous tendency to resist thinking, saying or doing it. In this situation, tension gradually rises until the patient gives in and gains temporary relief. The variety of compulsive behaviour is great, and its seriousness ranges from the harmless repetition of rituals, such as checking several times each night to see that lights are out and doors are locked, to seriously antisocial activities such as stealing, arson, exhibitionism and assault.

Compulsive behaviour has interesting normal homologues in the attitudes of children toward familiar tales and organized play, where the same tense insistence upon ritual and meticulous repetition can be found. The same is true of the reactions of normal adults in relation to etiquette, rules of procedure in civil and military organizations, in institutionalized games, theatre performances and patriotic or religious ceremonies Discussion of pathological compulsions will be limited to one well-known syndrome.

Repeated handwashing, the classical example in this group, illustrates the salient features of compulsive disorders. As a reaction to the self-accusation of guilt, it performs the function of symbolically cleansing and disowning responsibility. After it has been performed a number of times, because of sinful deeds or fantasies, it is likely to grow into a more general reaction to any tension, whether guilt is involved or not. The annoyance and inconvenience of having to wash repeatedly also constitutes punishment, and this aspect is increased when the application of cleansing agents eventually brings about a painful chemical dermatitis. The penitential meaning becomes clear when the patient complains then that he takes pleasure in hurting himself. One sees here the division of behaviour into the role of the punitive parent and the sinful penitent child, a dual role which the patient has usually acquired in childhood, through learning to be overconscientious at the hands of a hypercritical, perfectionistic parent.

**Hysterical Disorders.**—These are characterized by persistent inactivation or autonomy which superficially resembles the product of neurological damage and disease. Actually, no neurological lesion is present, and the disorder arises in relation to need or anxiety. Hysteria, or "conversion hysteria" as it is commonly called, differs from hypochondria in one important respect. The hypochondriacal patient shows marked overconcern in relation to an organ or part which is actually performing reasonably well. The hysterical patient shows relative unconcern with respect to an organ or part which is obviously disabled. This is because the hysterical patient, in accepting his symptom as a sign of disability, frees himself from the tensions of frustrated need and conflict. Hysteria can be distinguished from malingering, with which it is usually confused, by the fact that the patient is himself convinced of the verity of his symptom as a sign of damage or disease.

The commonest examples of hysterical inactivation are those of hysterical aphonia, paralysis, anaesthesia, blindness and amnesia. In hysterical aphonia, or loss of voice, the organs of speech are usually normal and their participation in activities other than talking may be unimpaired. Aphonia appears under circumstances similar to those inducing normal loss of voice—acute anxiety, fright, sudden surprise, extreme disappointment or conflict. It may also follow tonsillectomy, some minor injury or an infection, which interferes temporarily with speech. The disability persists if it disposes of the tensions of intolerable need or anxiety; and it may disappear with dramatic abruptness when it no longer performs this function.

Hysterical paralysis and anaesthesia are not nearly so common as they were early in the 20th century. The reduction in incidence seems to be the result of public education and the great care now exercised by medical examiners in avoiding suggestion. However, when they do occur they are both striking and instructive. A person finds, for example, that following a fright, accident or operation, he cannot walk or cannot move an arm. Examination of the inactivated part fails to reveal evidence of tissue pathology adequate to account for the symptom; but the outcome of psychotherapy demonstrates that it represents the patient's attempt at adjustment in relation to deep personal need or anxiety. The skin of a hysterically disabled arm or leg may also be found insensitive to ordinarily painful stimulation. Sometimes such anaesthesia occurs alone. Its origin and meaning are the same as in the case of hysterical paralysis. Hysterical blindness has similar roots, but its significance may also include symbolic implications such as unwillingness to recognize, and self-punishment for the sinful use of seeing.

Hysterical amnesia, the loss of recall, is usually selective for

certain kinds of past events, but sometimes it is global and covers a complete episode. Nothing illustrates the extreme operation of repression better than global amnesia A person, caught in an intolerable conflict situation, may escape from it by repressing all remembrance of it. He may go further and exclude also the responses by which he establishes his own identity When this happens, we have the patient who cannot remember his own name or his status in society. This is the man whom the newspapers call "victim of amnesia" He is in fact the victim of overcomplete repression; he has carried to an extreme an adjustive technique which all of us use in getting rid of anxiety and frustrated need

The commonest examples of autonomy are the hysterical tremor, cramp and tic. The tremor is a rapid oscillatory movement, the cramp is a severe sustained muscular contraction and the tic is a relatively complex, co-ordinated movement. All three occur in normal behaviour. We call them hysterical when they are persistent or recurrent, and arise from need or anxiety, not from physiological impairment, intoxication or tissue damage. The so-called "occupational" tremor, cramp or tic illustrates such a relationship For example, a machinist who is otherwise well finds that his hand shakes whenever he tries to work but not in other situations A typist suffers a painful cramp each time she tries to type but finds no difficulty in writing longhand A taxicab driver develops head jerking on the job which makes driving impossible, but the jerking does not occur when someone else does the driving. The symptom in each instance is the expression of an incompletely repressed conflict; and if the conflict is resolved, the symptom will usually clear up quickly

Three other varieties of hysterical autonomy are relatively rare but psychologically important. These are the seizure, the fugue and multiple personality. The hysterical seizure is usually a dramatic re-enactment of some personally important role in the patient's life. During the attack phase, which may last from a minute or two up to several hours, the patient excludes the biosocial environment almost completely. When not in an attack, he usually cannot recall the events re-enacted in the seizure In hysterical fugue, the patient runs away from his conflict situation and becomes amnesic for his past, often to the point of losing his identity. Fugues seem to be related to ordinary sleepwalking.

Multiple personality is an extreme form of hysterical autonomy to which both fugue and amnesia may contribute. In one form, alternating personality, two organized systems of biosocial behaviour develop and alternate in dominating a person's activities. Each system is amnesic for events in the other The fictional representative of this form is Robert Louis Stevenson's Dr. Jekyll and Mr. Hyde. It is estimated that not more than 150 authenticated cases of multiple personality have been reported.

**Paranoid Disorders.**—This term is reserved for more or less systematized delusional reactions in patients who show neither serious disorganization nor deterioration. They develop as a rule under conditions of unusual anxiety, emotional arousal, strong personal need or physiological incompetence They frequently lead to behaviour that is socially detrimental, inappropriate or inept. Paranoid disorders are relatively common and in most cases curable. The relatively rare paranoia is an extreme, rigid form in which elaborate, highly systematized delusions prevail; it is seldom curable.

Emotional factors are of great importance in the origin and persistence of delusions. The insecure, tense individual who is for any reason unskilled in the social techniques of give-and-take, upon which adequate interpersonal relationships depend, is particularly vulnerable In his anxiety or frustrated need, the patient becomes reaction-sensitive to the activities of persons around him which seem to confirm his suspicions or hopes. If this development goes on unchecked, he begins to feel that he is the focus, or an important part, of some concerted action on the part of other persons, some of whom are actual individuals and some imagined. This organization of the human environment in terms of delusion is called a paranoid pseudocommunity. It may be conceived of as malignant or benign by the patient. When it seems to him that he is about to be attacked or exalted, he is likely to take action which brings him confinement and, in fortunate cases, psychiatric treatment.

**Schizophrenic Disorders.**—Delusional reactions also develop along less well-organized lines, show fantastic characteristics, self-contradictory attitudes and hallucination, such as one finds in normal dreams and in delirium. The patient, however, is neither asleep nor delirious but, on the contrary, may be well oriented and able to carry on complex biosocial activities impossible for a sleeping or delirious person Some of these activities, in severe cases all of them, will inevitably show the influence of the fantastic, ambivalent, hallucinatory disorganization which is present. This is what we call schizophrenia or, more accurately, the schizophrenic disorders, since there are many clinical varieties. It is customary to distinguish four general types of schizophrenic disorder However, these are no longer regarded as mutually exclusive forms but only as descriptive statements of the dominant behaviour the patient shows at the time Thus, if he postures, gestures, shows great excitement or grows mute and stuporous, he is called catatonic. If poorly organized delusions dominate the clinical picture, the patient is called paranoid schizophrenic If the patient hallucinates freely and behaves in a silly, giggling manner, he is called hebephrenic; and if he seems to fit into none of these categories, he is labelled simple schizophrenic. The United States army classification of 1945 advises against forcing all diagnoses into these arbitrary types.

The most impressive characteristics of the schizophrenic person are his disorganization and desocialization. The biosocial behaviour systems that constitute personality are to a considerable extent replaced by behaviour determined and dominated by private fantasy. The patient includes his fantasy products in the reactions he gives to his environment (overinclusion), with the result that his social behaviour becomes disorganized. This disorganization, in turn, interferes with normal communication and participative activities and so promotes the desocialization and further isolates the patient. If this process continues, the patient's behaviour may pass from the organization of a poorly systematized pseudocommunity to that of an autistic community, made up of the imagined activities of fictitious persons in a fantasied context.

The severity of schizophrenic disorganization led long ago to the conclusion that it must result from cerebral damage or metabolic disease. Research over a period of 50 years failed to support this hypothesis; and the complete or partial recovery of about half the adequately treated cases, including many severe ones, tends to contradict it. There is good evidence to indicate that personality traits acquired in childhood and adolescence are determinative factors.

**Manic-Depressive Disorders.**—Manic excitements are circumscribed episodes of elation or marked aggressiveness usually with grandiose delusions. Depressions are either [illegible] which case sustained tension, restless overactivity, despair and apprehensive delusions predominate, or else retarded, in which case the patient shows marked slowing and restriction of activity, with sadness, self-depreciatory delusions and dejection. Suicidal attempts are extremely common in depression. The close relationship of manic excitement to depression was widely accepted by the ancients. The old name, manic-depressive insanity, seems first to have been used in a medical essay of the 17th century which described both types of attack in the same patient. Contrary to popular opinion, it is actually unusual for mania and depression to occur in succession, as a cyclic reaction Even those patients who have both types in widely separated attacks constitute only about one-fourth of the total in this group Agitated depressions occurring in middle life are commonly called involutional melancholias. There is no general agreement as to whether or not they are of endocrine origin, and whether or not they are essentially different from agitated depressions at other periods of life.

Within recent years there has been growing recognition of the evolution of mania and depression from severe, prolonged anxiety

As Karl Abraham and Freud pointed out, there is often strong emotional ambivalence toward loved persons in the premorbid situation; and at some point in the development the original hostility is turned, from the loved person, against the patient himself. This change, the crucial shift, marks the onset of agitated depression in which self-condemnatory accusations are typical. The same change, in another person, leads to the profound self-depreciation and hopelessness of retarded depressions. If the patient, on the other hand, rejects and disowns self-condemnation or self-depreciation, he may overcompensate by developing elated grandiosity or aggressive self-assertion; and this constitutes manic excitement. The arrogance and clowning of manic patients are frequently mistaken for signs of mere overconfidence and happiness by relatives and friends, whereas they are actually the symptoms of a serious illness which may involve an individual in grave difficulties, and sometimes leads to his death.

**Cerebral Incompetence.**—The brain as an organ, particularly its cerebrum, cannot function efficiently unless a physiological equilibrium is maintained within a rather narrow range. This equilibrium may be disturbed by marked changes in body temperature, blood pressure and blood volume, by alterations in the composition of tissue fluids, cerebrospinal fluid and blood and by intoxication, brain disease and brain degeneration. Sudden changes often precipitate acute cerebral incompetence, and we have delirium, stupour or coma. More gradual changes may be compensated physiologically for a long time; but if this compensation ends abruptly, the result will again be acute cerebral incompetence. If, instead, there is a gradual reduction in the adequacy of compensation, we have progressive cerebral incompetence.

The United States army classification excludes cerebral incompetence as nonpsychiatric, unless behaviour disorder can be demonstrated, in which case the cerebral incompetence is regarded simply as one aetiological factor.

Behaviour disorders develop in patients with acute or progressive cerebral incompetence if their reduced biosocial adequacy makes them unable to deal effectively with their anxieties and frustrations. Suppose that a person has acquired adjustive techniques earlier in life which take care of serious personal conflicts through repression, identification and rationalization (*see* DEFENSE MECHANISMS). If his brain, the organ upon whose integrity such complex learned behaviour depends, becomes physiologically incompetent through intoxication, infection, injury or degeneration, the patient may suffer a rearousal of these conflicts because his adjustive techniques have been impaired. The result will then be a neurotic or psychotic reaction, the character of which will depend less upon present conditions than upon the conflicts and the patient's premorbid personality. This relationship has been demonstrated for alcoholic intoxication, general paresis and pathological senility, each of which may set the stage for the development of any of the behaviour disorders described above.

By the mid-20th century, it had become generally recognized that psychoses, in the cerebrally incompetent as well as in the cerebrally competent, could no longer be dismissed as mere reflections of brain pathology, nor could their treatment be limited to custodial care. This change was paralleled by a growing realization that neurotic patients were neither weaklings nor malingerers, but persons with legitimate claims to the privileges accorded the sick. It was chiefly to the credit of Freud that behaviour disorders had finally achieved a status of equality with other illnesses.

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**ABO-BJ[illegible]**: *see* TURKU-PORI.

**ABODE.** In English law this term has a more restricted meaning than domicile, being used to indicate the place of a man's residence or business, whether that be either temporary or permanent. The law may regard for certain purposes, as a man's abode, the place where he carries on business, though he may reside elsewhere; so that the term has come to have a looser significance than residence, which has been defined as "where a man lives with his family and sleeps at night" (*R.* v *Hammond*, 1852, 17 Q B. 772) In serving a notice of action, a solicitor's place of business may be given as his abode (*Roberts* v *Williams*, 1835, 5 L. J M C. 23), and in more recent decisions it has been similarly held that where a notice was required to be served under the Public Health Act 1875, either personally or to some inmate of the owner's or occupier's "place of abode," a place of business was sufficient (*See* DOMICILE.)

**ABOLITIONIST,** an advocate of the abolition of slavery The term as used in the United States referred specifically to those persons who, during the years 1830–61, made it their mission to advocate the immediate abolition of Negro slavery. In spite of riots, assaults and persecutions of every kind, they carried on their task by means of the press, tracts, lectures and petitions to congress. Among the outstanding leaders of the abolitionist movement were William Lloyd Garrison, Wendell Phillips, Lucretia Mott and John Brown (*See* SLAVERY.)

**ABOMASUM,** the fourth or rennet stomach of ruminants It is that part of the digestive apparatus in which chemical digestion takes place. (*See* PECORA.)

**ABOMEY,** capital of the ancient kingdom of Dahomey, West Africa, now included in the French colony of the same name. Pop. (1936), 11,300, of whom 15 were Europeans. It is 70 mi. north by rail of the seaport of Kotonu. Abomey is built on a plain, 800 ft. above sea level. The town was surrounded by a mud wall, 6 mi in circumference, with a ditch 5 ft. deep, filled with a dense growth of prickly acacia, the usual defense of West African strongholds. There were six gates. Within the walls were villages separated by fields, several royal palaces, a marketplace and a large square containing the barracks. In Nov. 1892, Behanzin, the king of Dahomey, being defeated by the French, set fire to Abomey and fled northward. Under French administration the town has been rebuilt, placed (1905) in railway communication with the coast, and given an ample water supply. It is an important centre of fetish worship.

**ABOMINATION,** anything regarded with aversion as were things contrary to omen (Lat. *ab,* from, and *ominor,* forbode). Evil doctrines and impure ceremonial practices are so-called in the Bible. Hebrew authorities hold that the expression "abomination of desolation" (Matt. xxiv, 15; Mark xiii, 14) refers to the desecration of the sacred temple of Jerusalem by the erection of heathen statues (see *s.v. Jewish Encyclopedia*).

**ABOR** (*A-bari-* untamed), an Assam tribe inhabiting hills north of the Brahmaputra, subdivided into Minyong, Galong, Padam and other groups. They fall into patrilineal exogamous septs with traces of dual organization. A cross division exists into Mishing and Mipak—pure and impure, the latter condition being hereditary, and contagious as a result of sexual intercourse, though exogamy is not affected by it. The dead are buried; monogamy prevails, but the Galongs practise the levirate and polyandry within the family circle; slavery, tattooing and segregation of the unmarried obtain, but there is no headhunting. Public affairs are managed by elders and offenders are fined by the random confiscation of property; the property owner must execute the order of the court in order to recover from the culprit in his turn. Weapons used include long swords, crossbows, bows, poisoned arrows and spears. Men wear bark loincloths with tails, women a string of small circular metal plates—often the only garment.

*See* Duff-Sutherland-Dunbar, *Abors and Galongs* (1916); Cumming, *The Abors,* Assam Census Report, I, Appendix B, iii (1921).

**ABOR HILLS,** a tract of country on the northeast frontier of India, occupied by an independent tribe—the Abors, who are

Miri and Mishmi hills in the extreme north of Assam, where the Brahmaputra (Dihang) debouches on to the plain The country is exceedingly difficult and entirely mountainous and forest clad, with great rivers running for miles in rocky gorges, and unnavigable beyond Pasighat. Communication is only by the roughest tracks from village to village. The rainfall is very heavy. The term Abor is Assamese signifying "barbarous" and is applied by the Assamese to many frontier tribes; but is restricted especially to the above tract. The Abors frequently raided the plains of Assam. They were first visited by the English in 1826 From 1848 they carried out numerous raids and outrages on the neighbouring territory and several expeditions were sent against them, while a blockade was instituted from 1894–1900 From 1911 onward parties under military escort surveyed the border.

**ABORIGINAL LANGUAGES,** languages spoken by the native inhabitants of certain countries The term is generally applied to tongues called nonliterary languages, jargons, broken dialects, etc , but is more correctly used of languages which, whatever their state of development, have left their individuality unimpaired upon the territory where they originated. Aboriginal languages of Africa, for example, are the Bushman (*q v* ), dialects; of China, the Lolo (*q v* ), Man-tse, No-su, Mo-so, etc.

**ABORIGINES,** a mythical people of central Italy, supposed to have descended from near Reate (an ancient Sabine town) upon Latium, whence they expelled the Siceli and settled down as Latini under a King Latinus (Dion Halic. i, 9, 60). The etymology of the name (*ab origine*), makes them the original inhabitants (=Gr. *αὐτόχθονες*) of the country, but is inconsistent with the fact that the oldest authorities (*e g* , Cato in his *Origines*) regarded them as Hellenic immigrants, not as a native Italian people Other explanations suggested are *arborigines,* "tree-born," and *aberrigines,* "nomads."

The term "Aborigines" indicates the inhabitants found in a country at its first discovery. The Aborigines' Protection society was founded in 1838 in England as the result of a royal commission appointed at the instance of Sir T. Fowell Buxton to enquire into the treatment of the indigenous populations of the various British colonies

**ABORTION** means the termination of pregnancy before independent viability of the foetus has been attained. In humans, when modern facilities and expert care of the premature infant are available, such viability is at about the 26th week after the 1st day of the last normal menstruation. Miscarriage is the folk term for spontaneous abortion When this occurs before the 16th week of gestation, as it does in fully 75% of the cases, the foetus, if it were present at all, almost always has died two to five weeks before expulsion of the abortus. In about 50% of abortuses, no foetus is found; only an abnormal placenta (afterbirth) is present. If expulsion does not follow separation of the placenta or death of the foetus, the condition is called missed abortion and usually requires surgical removal of the abortus. It is estimated that about 12% of recognized pregnancies are aborted spontaneously. Meagre embryologic studies indicate that possibly 20% of fertilized ova are expelled before pregnancy can be diagnosed and that in about one-third of them no foetus, only placental tissue, is formed. Almost all the occult and most diagnosable miscarriages are caused by abnormal development of the embryo or the placenta. This is caused by intrinsic defects in the particular combining sperm or egg (the latter more frequent in women over 40 years of age), or occasionally to inadequacies of the lining of the womb where the ovum imbeds. In general, only an extreme dietary deficiency, a marked endocrine disorder or a gross toxic, anatomically defective or locally traumatized condition of the mother effectively impairs development of the normal conceptus The injurious role of the emotions is as yet entirely theoretic.

Adequate diet and good hygiene during childhood and adolescence will favour normality of male and female germ cells. The same treatment for the adult female with avoidance, correction or relief of disabilities mentioned as harmful to the conceptus will tend to supply its needs. When miscarriage is threatened by a showing of blood or by intermittent mild cramps, moderate sedation supplemented by inhibition of uterine contractions will help if the conceptus is still normal Contractions can usually be stopped by repeated intramuscular injection of at least ten milligrams of progesterone, the *corpus luteum* hormone, given at intervals no greater, and preferably less, than 48 hr. Inevitable abortion is associated with more or less haemorrhage, somewhat proportional to the duration of pregnancy, or with severe cramps, usually both. If evacuation of the uterus does not follow promptly, expert surgical removal of the abortus is indicated to prevent serious loss of blood Similarly, in cases where only part of the products of conception is extruded the rest should soon be removed surgically to avoid haemorrhage and infection

In most civilized countries, medical ethics and the law permit the deliberate termination of pregnancy, called therapeutic abortion, when the mother's health, life or reason is clearly jeopardized by continuance of the pregnancy and in the rare cases when grossly defective offspring can surely be expected. British law in 1938 recognized rape as justification. Even severely oppressive socioeconomic conditions alone are not valid reasons. He who wilfully causes abortion, as well as anyone who contributes to the act, in the absence of the indications mentioned, is liable to conviction of crime. As of 1947, no medical abortifacient is known that is effective without seriously endangering the mother's life. Surgical destruction and preferably prompt removal of the conceptus is the only effective therapeutic measure. In spite of the legal hazard and maternal risk, induced abortion destroys probably about 16% of diagnosable pregnancies in the United States, and doubtless many more in some European countries. The over-all mortality rate of legitimate therapeutic abortion is about 1%, lowest during the first weeks of pregnancy, increasing with age of gestation. The undiscoverable death rate of criminal abortion must be high, for in the United States in 1943, abortion contributed to 16% of maternal deaths.

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**ABORTION, CONTAGIOUS:** *see* BRUCELLOSIS.

**ABOUKIR,** a village on the Mediterranean coast of Egypt, 14½ mi. northeast of Alexandria by rail. The meaning of the name is "Father Cyrus," who was a Coptic saint. Stretching eastward as far as the Rosetta mouth of the Nile is the spacious bay of Aboukir, where on Aug. 1, 1798, Nelson fought the battle of the Nile. Near Aboukir, on March 8, 1801, the British army, commanded by Sir R. Abercromby, landed from its transports in the face of strenuous opposition from a French force entrenched on the beach.

**ABOUT, EDMOND FRANÇOIS VALENTIN** (1828–1885), French novelist, publicist and journalist, was born Feb. 14, 1828, at Dieuze, in Lorraine. Among his college contemporaries at the École Normale were Taine, Francisque, Sarcey, Challemel-Lacour and Prévost-Paradol. Of them all About was, according to Sarcey, the most highly vitalized, exuberant, brilliant and "undisciplined." After a brief period spent at the French school in Athens he returned to Paris, and became an industrious and lively journalist. About's attitude toward the empire was that of a candid friend. He greeted the liberal ministry of Émile Ollivier at the beginning of 1870 with delight, and welcomed the Franco-German War.

With the fall of the empire he became a republican, and, always an inveterate anticlerical, he fought against the conservative reaction which made progress during the first years of the republic. From 1872 onward for some five or six years his paper, the *XIX^e Siècle,* of which he was the heart and soul, became a power in the land. On Jan. 23, 1884, he was elected a member of the French academy, but died Jan. 16, 1885, before taking his seat. About's best work is to be found, not in the once famous *Roman d'un brave homme* (1880), but in the books that are almost wholly farcical, *Le nez d'un notaire* (1862); *Le roi des*

*montagnes* (1856); *L'homme à l'oreille cassée* (1862); *Trente et quarante* (1858); *Le cas de M. Guérin* (1862). Here his most genuine wit, his sprightliness, his vivacity and the fancy that was in him, have free play.

**ABRABANEL, ISAAC,** called also ABRAVANEL, ABARBANEL (1437–1508), Jewish statesman, philosopher, theologian and commentator, was born at Lisbon of an ancient family which claimed descent from the royal house of David. Like many of the Spanish Jews he united scholarly tastes with political ability. He was a favourite of King Alphonso V, who entrusted him with important state business, but after his death in 1481 Abrabanel was compelled to flee to Spain, where he held for eight years (1484–92) the post of a minister of state under Ferdinand and Isabella. After the expulsion of the Jews from Spain in 1492 Abrabanel resided at Naples, Corfu and Monopoli, and in 1503 removed to Venice, where he was a minister of state till his death in 1508. Abrabanel was one of the first to see that for biblical exegesis it was necessary to reconstruct the social environment of olden times, and he skilfully applied his practical knowledge of statecraft to the elucidation of the books of Samuel and Kings.

BIBLIOGRAPHY.—J. B. Trend and H. M. J. Loewe (ed.), *Isaac Abravanel* (1938); J. S. Minkin, *Abarbanel, and the Expulsion of the Jews from Spain* (1938); J. Sarachek, *Don Isaac Abravanel* (1938)

**ABRACADABRA,** a word analogous to Abraxas (*q.v.*) used as a magical formula by the Gnostics of the sect of Basilides in invoking the aid of beneficent spirits against disease and misfortune. It is found on Abraxas stones, which were worn as amulets. The Gnostic physician Serenus Sammonicus gave precise instructions as to its mystical use in averting or curing agues and fevers generally. Subsequently its use spread beyond the Gnostics, and in modern times it is applied contemptuously to complicated, unscientific hypotheses.

**ABRAHAM** or (Genesis xi, 26–xvii, 5) **ABRAM** is the progenitor of the chosen people, the "seed" of the "promised land," Canaan (Gen. xii, 7; xiii, 15; xv, 18, etc.). He was the



ABRAHAM, THE FIRST OF THE GREAT BIBLICAL PATRIARCHS, BEING PREVENTED BY AN ANGEL FROM OFFERING UP HIS SON, ISAAC, AS A SACRIFICE. AFTER A RELIEF OF THE LIFE OF ABRAHAM ON THE DOORS OF THE BAPTISTERY, FLORENCE, BY GHIBERTI

first of the three Patriarchs He was extolled as "the Friend of God" (Isa. xli, 8; II Chron. xx, 7; *cf.* James ii, 23, and also the Mohammedan tradition), and as the "Father of the Faithful" (*cf.* Rom. iv, 11). To the present day the Jews trace their descent from him and from his progeny; who in accordance with the promise were to be as numerous as "the stars in the sky" (Gen. xv, 5) and "the sand on the sea shore" (Gen. xxii, 17). On the other hand in the New Testament it is declared that God can raise up children unto Abraham from stones (Matt. iii, 9), possibly an allusion to the myth of Deucalion and Pyrrha or to an Aramaic play upon words (*b'nīn* "sons," *abnīn* "stones"). To rest in Abraham's bosom, the bosom of the progenitor of the race, was the summit of eternal peace (Luke xvi, 22 *et seq.*).

**The Different Accounts.**—The stories in Gen. xi, 27–xxv, 11 belong to a larger whole. The basic conception upon which they are chosen and brought together is a single one. Despite all human opposition and despite all apparent despair and hopelessness, God holds forth his promise and brings to realization his scheme of salvation. Abraham, the bearer of this promise, is the pattern of peaceful and childlike faith, who stands firm against all dangers and disappointments. From the first his difficulties were exceedingly great.

He had to leave his home and people and, following the course of the sun, go on into a foreign land, the very name of which has not been told to him by God (Gen. xii, 1). The mighty Canaanites prevent his peaceful establishment (Gen. xii, 6), so he tarries in Shechem (xii, 6), Bethel (xii, 8), Hebron (xiii, 18), Gerar (xx, 1) and Beersheba (xxi, 33). At the very beginning he is compelled by a famine to leave Canaan and to go into Egypt, where his wife Sarai (Sara) is in danger through his untruth (Gen. xii, 10–20, *cf.* xx, 1–18, where the scene is Gerar). Hardly has he again settled in Canaan when dissensions among the shepherds bring a new danger, and he has to part from his only kinsman Lot. In calm trust in God, Abraham leaves the choice of locality to Lot (xiii, 9), who chooses the fruitful land on the other side beyond the borders of the promised land. Further difficulties arise when Lot falls into captivity (xiv) and, finally, into extreme danger, at the destruction of Sodom (ch. xix). Nevertheless here also Abraham's trustful confidence prevails, and he receives the promise of God in the form of a covenant (xv and xvii). There was to be born a son to the aged and childless couple and Abraham *believed:* his calm, childlike trust represents the just relation between man and God. This is the real meaning of the famous verse (Gen. xv, 6) with which, in the New Testament, the profoundest thoughts of the Christian doctrine of justification are connected (Rom. iv, 3; Gal. iii, 6).

A new side-issue is Abraham's marriage with Hagar, for the offspring of that union, Ishmael, cannot be heir (Gen. xvi, *cf.* xxi, 8 *et seq.*). Finally Isaac, "the son of promise," is born (xxi, 1 *et seq.*), and Abraham by means of a covenant with the king of Gerar gets a footing near the borders of the promised land (xxi, 22 *et seq.*). Then comes the severest test of his faith: the son of the promise must be willingly sacrificed! Even this test Abraham stands and God renews the promise (xxii), and yet toward the end of his days all that he has acquired as his estate is a grave (xxiii). This tomb of the Patriarch near Hebron is the sign that one day the whole territory shall belong to his descendants. Isaac, it it true, is still without an heir when Abraham dies in a good old age; and the old man's last thoughts concern themselves with the marriage of his son with a woman from his far-off home (xxiv). For Isaac is the heir, not Ishmael, or the children of Keturah; and Abraham has gained nought in the land of Canaan but a grave and his belief in the Promise.

**Analysis of Sources.**—These stories do not form a unity. The isolated stories whose concrete perspicuousness and brevity are unsurpassed are woven into a garland of sagas. They were collected in three or four larger works and finally put together in their present form, from the above-mentioned point of view. (*See* BIBLE: *Old Testament* and GENESIS.) To the latest work, the so-called Priestly Codex (P.), are ascribed Gen. xi, 27, 31, 32; xii, 4*b*, 5; xiii, 6, 11*b*, 12; xvi, 1*a*, 3, 15, 16; xvii; xix, 29; xxi, 1*b*, 2*b*–5; xxiii; xxv, 7–11*a*. As the work of the Elohist (E) are reckoned chapters xv and xxiv (?) in part, and nearly all of chapters xx, xxi and xxii. The rest belongs to the works of the two Jahwists (L, *i.e.*, the older "Lay-source" [so Eissfeldt] and J). The accuracy of this analysis is, however, in some details doubtful More important is the fact that the stories, despite many noticeable duplications (*cf.* xii, 10 *et seq.* and xx; xv and xvii; xvi and xxi), agree in all essentials. The etymological

explanations of names and word-plays are of fundamental importance as stylistic criteria.

**Historical Value.**—The style and content of the stories deviate from strictly historical writing. The narrative does not concern itself with the political, social and economic events and conditions in the life of the peoples (with the sole exception of xiv, on which see below), but with family idylls, delineated with an artist's love, the details of which, however, are beyond the reach of the historian. The question, therefore, of the real historical worth of the details is difficult to decide. On the other hand, scepticism as to the historicity of the patriarch himself goes too far. Some would suppose that the figure of Abraham owes its origin merely to the imagination of the poet; or that Abraham is merely a personification of the people who derived themselves from him, and that the sagas and legends concerning him and other patriarchs are only a reflection of later tribal history. According to other scholars, the heroic figure of Abraham is based on a Canaanite god who was worshipped in the holy trees of Shechem and Hebron. In this case the Israelites are supposed to have taken over the cult-centres and the rites; although, judging from their hatred of the earlier peoples, it is not very likely that they humanized their gods and heroes and regarded them as the progenitors of their own people All these explanations, however, have an air of unreality about them. From beginning to end all that Abraham does and suffers is peculiar to individuals. Mythical outlines are wholly wanting, even miracles are not ascribed to him (in contrast, for example, to Moses). Even his human failings are not disguised (his untruth, xii, 13; xx, 2; his frailty, xvi, 6; his doubts, xvii, 17). Were his shape devised with something of the idea of establishing Israel's right to Canaan, one would look for some other sort of figure. According to the later sagas—some of which have been preserved—the Patriarchs were mighty heroes who conquered the land with signs and miracles, and held firmly to the later sacrificial and food laws. It is just the unfavourable traits in the characters of the Patriarchs and the undesirable traits in their lives, and the consciousness of a difference between the patriarchal and the Mosaic period as regards the idea of God and the cults, that must rest on an historical foundation.

**The Two Names: Abram and Abraham.**—The double name is peculiar, *Ab-ram* means "the father is exalted" or "the exalted father"; the word "Patriarch" is really nothing more than a Greek translation of this name. Lesser known bearers of the name were called *Abiram* (Num. xvi, etc.). *Ab-rāhām* is the new name which the patriarch received from God from the moment of the solemn covenant (Gen. xvii, 5). A new name—mostly with a slight variation (*cf.* Sarai-Sara, Hosea-Joshua, Eliąkim-Jehoiakim, Saul-Paul)—indicates a new period in the life of the bearer. This name is explained in Gen. xvii, 5 as "Father of a Multitude," which in Hebrew would be *Ab-hamon;* but the second part of the compound is preferably compared with an Arabic word for "crowd" (*rūhām*). This explanation is however probably a popular etymology: it is most probable that the two names Abram and Abraham mean precisely the same thing. *Abram* may be the Accadian (Babylonian) and *Abraham* the Amorite (Canaanite) form of the same name. It is among the Amorite peoples in Babylonia during the first dynasty that names are found like *Abaram, Abam-rama,* and probably even *Aba-raham* (*cf.* for the last form Lutz, *Early Babylonian Letters from Larsa* [1917], No. 15). Thus it seems that this name was in use in Abraham's old Babylonian home, the regions of Ur and Larsa.

**Chronological Questions.**—For determining the date of Abraham the 14th chapter of Genesis is the starting point. In this noteworthy chapter are given the names of kings and lands, and Abraham appears as a warlike hero. The identification of these kings with the great Babylonian king Hammurabi and those of his time would seem to be erroneous. It is probable that the chapter deals with a punitive expedition undertaken by two princes of the middle Euphrates (*Amraphel;* i.e., *Amur-apil* and *Arioch* or *Āriaka*) in the service of the allied kings of *Khatti* (*Tid'al;* i.e., *Tid'alia, Dudhalia*). They were beaten by the attack of a much smaller number of Hebrews under Abraham: it was the unforgettable first military exploit of this people on Canaanite soil. Now, of these kings we know from the cuneiform inscriptions that Tid'al I was the founder of a dynasty of the kingdom of the Hittites (Khatti), and that he lived somewhere about 1550 B.C (or at the latest 1450 B.C.). It is therefore probable that we must place the time of Abraham about this date. With this agrees the little that is known of the political life of the dark age after the downfall of the Hyksos kingdom. The biblical chronology does not actually contradict this late dating, for the dates in Gen. xxi, 5; xxv, 26; xlvii, 9; Exod xii, 40 and 1 Kings vi, 1 belong to an artificial scheme, whereby precisely 12 centuries elapse from the birth of Abraham to the building of Solomon's temple. To make up these 12 centuries the length of a generation was reckoned first as 100 years, then as 40. But the older literary sources in the Old Testament give another picture; above all, the genealogical tables present good ancient evidence. On the basis of statements such as are found in Gen. xv, 16; xxxvi, 31–39 (*cf.* Num. xx, 14), Gen. l, 23; Exod. vi, 16–20, Ruth iv, 18–22, the period between Abraham and David must at the most be reckoned as 600 years, probably much shorter.

From the historical point of view Abraham's journey from Mesopotamia to Canaan is directly bound up with the wandering of the Moabites, Ammonites and Edomites to the southwest and southern Canaan, and with the wandering of the Aramaeans to Syria. An invasion by the non-Semitic tribes of the Mitanni and Kharri (about 1600 B.C.) expelled these Hebrews and Aramaeans from their old homes on the middle Euphrates, in a southwesterly direction. In the course of this migration individual Hebrew families (viz., Abraham and his kindred) came to Canaan; but there was no intention in the first instance of conquering this ancient land of culture.

**The Religious Significance.**—It has been shown that Abraham's journey from Ur (Gen. xi, 28) *via* Harran (xi, 31) to Canaan was merely a part of a greater movement of peoples. But, according to Biblical tradition, this journey had a precise objective and aim; God's direct command already contained a religious motive (Gen. xii, 1 *et seq*). Abraham is no leader of a Bedouin tribe seeking plunder and conquest; his significance lies rather in the field of religion. He is not, in the first instance, the progenitor of the people but the founder and leader of a religious movement. Like Mohammed, some 2,000 years later, he stood at the head of a great movement among the Semitic peoples and tribes. Naturally, his adherents were bound to each other firmly by blood ties. Abraham's religion was characterized by abstraction and was yet personal. The *one* great God, throned in heaven, honoured without priests and temple, the Almighty and all-comprehending One, to whom the faithful have personal access—this is Abraham's God so far as we can gather from our sources. And that is more important for us than the question of the details of the tradition. While Abraham's forefathers in Mesopotamia served other gods (Josh. xxiv, 2), "The God who redeemed Abraham" was the same as the God of Moses (*cf.* Exod. iii, 6, 13 *et seq.*) and of Elijah (1 Kings, xviii, 36). According to the Old Testament, Abraham was the founder of the Israelite faith, and Moses the founder of the nation's thought and reformer of the cultus. *See* GENESIS.

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**ABRAHAM, WILLIAM** (1842–1922), British Labour politician of the old school, was born in the Afon valley and went to work in a coal mine at the age of nine. He was affectionately known by the name of Mabon, a name originally adopted by him in Eisteddfod competitions. President of the South Wales Miners' federation, he was a power in South Wales, and he remained a

respected figure to the end. He sat in the house of commons for Rhondda from 1885 to 1920 and died on May 14, 1922.

**ABRAHAM, THE PLAINS OF,** a plateau to the southwest of the city of Quebec, the scene of the historic battle between the French under Montcalm and the English under Wolfe on Sept. 13, 1759. (*See* QUEBEC.)

**ABRAHAM A SANCTA CLARA** (1644–1709), Austrian divine, was born at Kreenheinstetten, near Messkirch. His real name was Ulrich Megerle. In 1662 he joined the order of Barefooted Augustinians, became a popular preacher and assumed the name by which he is known. In this order he rose step by step until he became *prior provincialis* and *definitor* of his province. He died at Vienna on Dec. 1, 1709. In his published writings he displayed the same force and homeliness as in the pulpit.

BIBLIOGRAPHY.—His works have been several times reproduced in whole or in part, though with many spurious interpolations. The best edition is that published in 21 vol. at Passau and Vienna (1835–54). *See* Th. G. von Karajan, *Abraham a Sancta Clara* (Vienna, 1867); H. Mareta, *Über Judas d. Erzschelm* (Vienna, 1875); Schnell, *Pater A. a S.C.* (Munich, 1895); Sexto, *Abraham a S.C.* (Sigmaringen, 1896); Blanckenburg, *Studien über die Sprache Abrahams a S.C.* (Halle, 1897).

**ABRAHAM IBN DAUD** (*c.* 1110–80), Jewish historiographer and philosopher of Toledo. His historical work was the *Book of Tradition* (*Sepher Haqabala*), a chronicle down to the year 1161. It was translated into Latin by Génébrad (1519). His philosophy was expounded in an Arabic work better known under its Hebrew title *'Emunah Ramah* (*Sublime Faith*). This was translated into German by Weil (1882). Ibn Daud was one of the first Jewish scholastics to adopt the Aristotelian system. Maimonides owed a good deal to him.

**ABRAHAMITES,** a sect of deists in Bohemia in the 18th century, who professed to be followers of the precircumcised Abraham. Believing in one God, they contented themselves with the Decalogue and the Paternoster. Declining to be classed either as Christians or Jews, they were excluded from the edict of toleration promulgated by the emperor Joseph II in 1781, and were deported to various parts of the country, the men being drafted into frontier regiments. Some became Roman Catholics, and those who retained their "Abrahamite" views were not able to hand them on to the next generation. As a religious sect they disappeared by the end of the century.

**ABRAHAM-MEN,** the nickname for vagrants who infested England in Tudor times. The phrase is as old as 1561, and was due to these beggars pretending that they were patients discharged from the Abraham ward at Bedlam.

On his discharge the genuine Bedlamite, provided he wore a badge, was allowed to roam the country, soliciting alms. This humane privilege was grossly abused, and thus gave rise to the slang phrase "to sham Abraham."

**ABRANTES,** a town of central Portugal, in the district of Santarem, formerly included in the province of Estremadura. It is on the right bank of the river Tagus, at the junction of the Madrid-Badajoz-Lisbon railway with the Guarda-Abrantes line. Pop. (1940), 4,170. Abrantes, which occupies the crest of a hill covered with olive woods, gardens and vines, is a fortified town, with a thriving trade in fruit, olive oil and grain. As it commands the highway down the Tagus valley to Lisbon, it has usually been regarded as an important military position. Originally an Iberian settlement, founded about 300 B.C., it received the name Aurantes from the Romans; perhaps owing to the alluvial gold (*aurum*) found along the Tagus.

Roman mosaics, coins, the remains of an aqueduct, and other antiquities have been discovered in the neighbourhood. Abrantes was captured on Nov. 24, 1807, by the French under Gen. Andache Junot, who for this achievement was created duke of Abrantes. By the Convention of Cintra (Aug. 22, 1808) the town was restored to the British and Portuguese.

**ABRASIVES.** Abrasion is a scratching action and depends on the relative hardness of the two materials—the abrasive and the one abraded. The degree of hardness of a material, as determined by scratching, has long been used by mineralogists for distinguishing one mineral from another, and F. Mohs in 1820 devised a scale of hardness for minerals, which is still in use. Mohs's scale is:—

| | | |
|---|---|---|
| 1. Talc | 5. Apatite | 8. Topaz |
| 2. Gypsum | 6. Feldspar | 9. Corundum |
| 3. Calcite | 7. Quartz | 10. Diamond |
| 4 Fluorite | | |

Diamond at No. 10 is the hardest of all minerals and indeed of all known substances. Steel (a knife-blade or file) will scratch feldspar but not quartz, and it is itself scratched by quartz; it can therefore be set at $6\frac{1}{2}$ on the scale. Window-glass at $5\frac{1}{2}$ can be abraded and polished by feldspar. The higher a material stands in the scale the more efficient is it as an abrasive, diamond being the most efficient of all.

Mohs's scale is arbitrary and merely comparative, and it gives no absolute measure of the degree of hardness of a material. Attempts have been made to arrive at this by various methods: such as by measuring under a microscope the depth of scratch produced by a diamond point under a certain load; or by determining the amount of work done in grinding away a certain weight or volume of material. From such experiments it is found that the gap between 10 and 9 on Mohs's scale is even greater than that between 9 and 1, emphasizing again the efficiency of diamond as an abrasive.

Brittleness or friability is another physical character to be considered in addition to hardness. Carborundum although exceeding corundum in hardness is much more brittle, and it soon crushes and rubs down to a fine flour. Diamond with rough usage breaks along the directions of perfect cleavage in the crystal. For this reason carbonado, a compact aggregate of minute diamond crystals, rather than a single crystal, is used in rock-drills.

The form in which abrasives are used varies for different purposes. The material may be crushed and sieved to different degrees of fineness. This may be used as a loose powder for grinding; or it may be glued on cloth or paper, or bonded with cements in the form of grinding wheels or hones. Other abrasives are used in block form cut to a suitable shape, as grindstones, millstones, scythestones, whetstones, pumice blocks, etc. Besides being used for grinding and polishing metal, stone, wood, leather, etc., abrasives are also employed for cutting, drilling and boring.

In addition to natural minerals, certain artificial products are also used for abrasive purposes. For example, powdered glass as glass paper, crushed steel for stone cutting, and the important carborundum. Corundum is also produced artificially on a large scale. Carbides of boron, tantalum and tungsten are extremely hard, and these may in the future find technical applications.

In the following list the various abrasive agents are arranged according to their degree of hardness, *i.e.*, in the order of their efficiency. Further information respecting each of these materials will be found in the separate articles (*see* DIAMOND, etc.).

*Diamond* (Hardness = 10). This is a crystallized form of carbon, and only the natural mineral is available. Cloudy, spotted and imperfectly crystallized stones, known as bort, and small fragments that cannot be cut as gems are crushed to powder for use as an abrasive. Diamond powder is the only material with which diamond itself can be ground and polished.

*Carborundum* (H. = $9\frac{1}{2}$). This artificial product is a crystallized carbide of silicon (CSi), and since its discovery in 1891 it has more and more replaced mineral abrasives. It is produced in large quantities by heating coke and sand in electric furnaces. It is used in the form of powder either loose or on cloth, or is made up with porcelain, shellac or other bonding material in the form of grinding wheels, hones, etc. This material is sold under a variety of trade names—crystolon, carbolon, samite, etc.

*Corundum* (H. = 9) is the crystallized oxide of aluminum ($Al_2O_3$), a mineral which in its gem varieties is ruby and sapphire. Rough corundum is found as large crystals in certain kinds of igneous rock in Canada, North Carolina, Ural mountains, Madagascar, and South Africa, the last being now the principal producer of material for abrasive purposes. *Emery* is an impure granular variety of corundum mixed with magnetite and other minerals, and it is not quite so hard as the purer crystal or rock corundum. It is mined in Naxos, Asia Minor and the state of New

York. Much corundum is now produced artificially by fusing bauxite in electric furnaces, the product being sold under the names alundum, adamite, aloxite, lionite, etc.

*Garnet* (H.=6½–7½) as mined in the eastern United States and in Spain for abrasives is mainly the almandine variety, a silicate of iron and aluminum. It is largely used for making garnet paper (often sold as emery paper).

*Quartz* (H.=7) is a crystallized form of silica (oxide of silicon, $SiO_2$) and is the commonest of all minerals, occurring in a bewildering variety of forms It finds extensive applications as an abrasive. Millstones, grindstones and pulpstones (for grinding wood in the manufacture of paper) are made of quartzite, burrstone, grit or sandstone. Whetstones are made of hornstone, Lydian stone, Arkansas stone, and other compact varieties of quartz. In the form of sand, quartz is used as a sandblast, as sandpaper, in scouring soap, and for cutting and grinding marble Pebbles and flints are used for grinding cement materials and clinker.

*Steel* (H.=6½) Crushed crucible steel, crushed cast iron and steel shot are used in stone cutting.

*Feldspar* (H.=6), the potash-feldspar, orthoclase or microcline ($KAlSi_3O_8$), is used for polishing plate glass and in scouring soaps.

*Glass* (H.=5½), powdered glass as glass paper or sandpaper.

*Pumice* (H =5½), a natural volcanic glass blown by included steam into a cellular mass. The best block pumice is from the Lipari Islands, and enormous quantities of pumice-dust are available in the United States.

*Opal* (H.=5), a hydrated glassy form of silica, found in a powdery form as large deposits of tripoli, diatomaceous or infusorial earth, and largely used for polishing and in scouring soap.

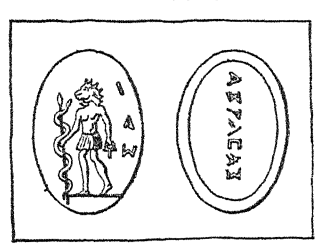
Rottenstone, chalk, rouge, putty powder and other softer grinding and polishing materials might also be mentioned.

Abrasives, in the household, are substances of an erosive nature used for polishing or cleaning purposes. Those best suited for this use are fine sand, emery, crushed pumice and chert, which consists of siliceous skeletons of sponges and marine shells. These materials are often mixed with a solution of soap, so that there is a cleansing action as well. In the cleaning of aluminum, steel wool, in combination with an abrasive powder or soap, has a wide usage. Abrasives are in very general use and have done much to lighten the housewife's work They may be purchased in paste, powder or cake form and used for cleaning and polishing all kinds of metals, as well as scouring paint and enamelware.

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**ABRAUM SALTS** (from the German *Abraum-salze*, salts to be removed), the name given to a mixed deposit of salts, including chlorides and sulphates of sodium, potassium and magnesium, found in association with rock salt at Stassfurt in Prussia.

**ABRAXAS** or **ABRASAX,** a word probably first used by the Basilidians and engraved on certain antique stones, called on that account "Abraxas stones." The letters of ἀβραξάς in the Greek notation make up the number 365, and the Basilidians gave the name to the 365 orders of spirits which emanated in succession from the supreme being. These orders were supposed to occupy 365 heavens, each fashioned like but inferior to that above it, the lowest being the abode of the spirits who formed the earth and its inhabitants, to whom was committed the administration of its affairs. In addition to the word Abraxas the stones often have cabalistic figures engraved on them.




BY COURTESY OF THE BRITISH MUSEUM

OBVERSE AND REVERSE OF AN ABRAXAS STONE ATTRIBUTED TO THE BASILIDIANS

**ABROGATION,** the annulling or repealing of a law by legislative action or by usage. Abrogation, which is the total annulling of a law, is to be distinguished from the term *derogation,* which is used where a law is only partially abrogated Abrogation may be either express or implied It is express either when the new law pronounces the annulment in general terms, as when in a concluding section it announces that all laws contrary to the provisions of the new one are repealed, or when in particular terms it announces specifically the preceding laws which it repeals. It is implied when the new law contains provisions which are positively contrary to the former laws without expressly abrogating those laws. The abrogation of any statute revives the provisions of the common law which may have been abrogated by that statute (*See* STATUTE; REPEAL)

**ABRON,** a longheaded tribe, physically akin to the Fanti, living on the Ivory Coast (Bondoukou region) and between Kintampo and Salaga, Gold Coast. The natives are husbandmen and traders, and they practise Animism There are small kingdoms made up of several provinces. The family is constituted by several subgroups which embrace a number of households. Marriage between cross-cousins is frequent. Descent is reckoned in the paternal lines. Inheritance passes to the maternal uncle, then to the nephew, the sister's son. Society consists of (1) nobles, (2) freemen, and (3) slaves and descendants of slaves. The judiciary organization is fairly well developed

*See* Tauxier, *Le Noir de Bondoukou* (1921).

**ABRUZZI, DUKE OF THE** (1873–1933), Italian vice-admiral and explorer, son of Amadeo, duke of Aosta, was born at Madrid Jan. 29, 1873, and named Luigi Amadeo. Although he had a distinguished naval career he achieved fame also as a traveller and mountaineer. He was the first to ascend Mt. St. Elias in Alaska (1897) and in 1899 he organized a North Pole expedition, part of which reached lat. 86° 3′ N., at that time the record of northern exploration, he himself being forced to remain behind owing to frostbite. In 1906 he was the first to ascend the Ruwenzori in East Africa, reaching the twin summits (16,795 ft.) which he named Margherita and Alexandra. He also made the first detailed map of the Ruwenzori. In 1909 he ascended K 2 in the Himalayas to an altitude of over 20,000 ft. and on July 18 Bride peak to 24,600 ft. During World War I he commanded the naval forces in the Adriatic, but he resigned in 1917 owing to disagreements with Admiral Thaon di Revel, his chief of staff, and retired from the service. Afterward he undertook to carry out an important colonization scheme in Italian Somaliland.

English translations of his works are *The Ascent of Mount St. Elias* (1900); *Ruwenzori* (1909).

**ABRUZZI E MOLISE,** a group of provinces (*compartimento*) of south central Italy. The area is 5,954 sq mi. and the population (1936) 1,600,631. The interior is mountainous including the central portion of the Apennines and their culmination, the *Gran Sasso d'Italia*. The coastal hills consist mainly of somewhat unstable clay and sand; the zone of level ground along the coast is quite inconsiderable. The 100 mi. of coast have not a single harbour of importance. Climate varies with altitude, the highest peaks being covered with snow for most of the year, while the valleys running northeast toward the sea are fertile and well watered by several small rivers, the chief of which are the Tronto, Vomano, Pescara, Sangro, Trigno and Biferno. These are fed by minor streams, such as the Aterno and Gizio, with valleys between the main chains of the Apennines. They may be suddenly swollen by rains, and floods and landslips often cause damage. This danger has been increased, as elsewhere in Italy, by indiscriminate timber-felling without provision for reforestation, though considerable oak, beech, elm and pine forests still exist and are the home of wolves, wild boars and even bears. The woods have large herds of swine, and the hams and sausages of the Abruzzi are famed. The rearing of cattle and sheep was at one time the chief occupation, and many flocks are still driven down to the Campagna di Roma for the winter and back again in the summer, but more cultivation is now done, especially in the valleys and in the now drained bed of Lago Fucino where beet sugar is produced. Industries are small but various: *e.g.*, arms and cutlery at Campobasso and Agnone and majolica at Castelli and elsewhere. Liqueurs are also made in several places. The river Pescara and its tributary the Tirino form an important source of power for generating elec-

tricity. Communications are not easy. Railways are (1) the coast railway (a part of the Bologna-Brindisi line), with branches from Giulianova to Teramo and from Termoli to Campobasso, (2) a line diverging S.E. from this at Pescara and running via Sulmona (whence there are branches via Aquila and Rieti to Terni, and via Carpinone to [a] Isernia and Caianello, on the line from Rome to Naples, and [b] Campobasso and Benevento), and Avezzano (whence there is a branch to Roccasecca) to Rome, (3) a connecting line between the coast (at Ortona and S. Vito Lanciano) and the line from Solmona to Isernia (at Castel di Sangro). There are, consequently, no large towns The district was, in Lombard times, part of the duchy of Spoleto and, under the Normans, a part of that of Apulia; it was first formed into a single province in 1240 by Frederick II who placed the *Justiciarius Aprutii* at Sulmona and founded the city of Aquila After the Hohenstaufens lost their Italian dominions the Abruzzi became a province of the Angevin kingdom of Naples, to which it was of great strategic importance.

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**ABSALOM,** the third son of David, and his father's favourite. The picture presented in II Sam. xiii–xix (which deals mainly with his life) suggests that he was the Alcibiades of the Old Testament, alike in his personal attractiveness, his lawless insolence and his tragic fate He is first mentioned as murdering his half-brother Amnon, David's eldest son, in revenge for the rape of his full sister Tamar This deed drove him into banishment, but he was eventually restored to favour through the good offices of Joab. Later, when some uncertainty seems to have arisen as to the succession, Absalom organized a revolt. For a time he seemed to be completely successful; David with a few followers and his personal guard fled across the Jordan, leaving to Absalom Jerusalem and the main portion of the kingdom. The usurper pursued the fugitives with his forces but was completely defeated in "the wood of Ephraim" (apparently west of Jordan, if the text be right), and killed by Joab, who found him caught by the hair in an oak tree. To the affectionate chivalrous heart of David, the loss of his son, worthless and treacherous as he was, brought grief which more than outweighed his own safety and restoration.

**ABSALON** (*c.* 1128–1201), Danish archbishop and statesman, was born about 1128, the son of Asser Rig of Fjenneslev, at whose castle he and his brother Esbjorn were brought up with the young prince Valdemar, afterward Valdemar I He was sent later to the University of Paris. Absalon first appeared in Saxo's chronicle as a fellow-guest at Roskilde, at the banquet given in 1157 by King Sweyn to his rivals, Canute and Valdemar. Both Absalon and Valdemar narrowly escaped assassination at the hands of their treacherous host on this occasion, but at length escaped to Jutland, where Sweyn followed them, to be defeated and slain at the battle of Grathe Heath.

In the same year (1158) in which Valdemar ascended the Danish throne, Absalon was elected bishop of Roskilde. Henceforth Absalon was the chief counsellor of Valdemar, and the promoter of that imperial policy which, for three generations, was to give Denmark the dominion of the Baltic. Briefly, it was Absalon's intention to clear the northern sea of the Wendish pirates, who inhabited that portion of the Baltic littoral which we now call Pomerania, and ravaged the Danish coast so unmercifully that at the accession of Valdemar one-third of the realm of Denmark lay waste and depopulated. The very existence of Denmark demanded the suppression and conversion of these stiff-necked pagan freebooters, and to this double task Absalon devoted the best part of his life.

The first expedition against the Wends, conducted by Absalon in person, set out in 1160, but it was not till 1168 that the chief Wendish fortress, at Arkona in Rügen, containing the sanctuary of their god Svantevit, was surrendered, the Wends agreeing to accept Danish suzerainty and the Christian religion at the same time. From Arkona Absalon proceeded by sea to Garz, in South Rügen, the political capital of the Wends, and an all but impregnable stronghold But the unexpected fall of Arkona had terrified the garrison, which surrendered unconditionally at the first appearance of the Danish ships Absalon, with only Sweyn, bishop of Aarhus, and 12 "housecarls," thereupon disembarked, passed between a double row of Wendish warriors, 6,000 strong, along the narrow path winding among the morasses, to the gates of the fortress, and, proceeding to the temple of the seven-headed god Rugievit, caused the idol to be hewn down, dragged forth and burned. The whole population of Garz was then baptized, and Absalon laid the foundations of 12 churches in the isle of Rugen.

The destruction of this chief sally-port of the Wendish pirates enabled Absalon to reduce considerably the Danish fleet But he continued to keep a watchful eye over the Baltic, and in 1170 destroyed another pirate stronghold, farther eastward, at Dievenow on the isle of Wollin. Absalon's last military exploit was the annihilation, off Strela (Stralsund), on Whitsunday 1184, of a Pomeranian fleet which had attacked Denmark's vassal, Jaromir of Rugen

He was now only 57, but his strenuous life had aged him, and he was content to resign the command of fleets and armies to younger men, like Duke Valdemar, afterward Valdemar II, and to confine himself to the administration of the empire which his genius had created. The aim of his policy was to free Denmark from the German yoke. It was contrary to his advice and warnings that Valdemar I rendered fealty to the emperor Frederick Barbarossa at Dôle in 1162; and, when, on the accession of Canute V in 1182, an imperial ambassador arrived at Roskilde to receive the homage of the new king, Absalon resolutely withstood him.

"Return to the emperor," cried he, "and tell him that the king of Denmark will in no wise show him obedience or do him homage."

As the archpastor of Denmark, Absalon also rendered his country inestimable services, building churches and monasteries, introducing the religious orders, founding schools and doing his utmost to promote civilization and enlightenment. It was he who held the first Danish synod at Lund in 1167. In 1178 he became archbishop of Lund, but very unwillingly, only the threat of excommunication from the Holy See finally inducing him to accept the pallium. Absalon died on March 21, 1201, at the family monastery of Soro, which he himself had richly embellished and endowed.

Absalon remains one of the most striking and picturesque figures of the middle ages, and was equally great as churchman, statesman and warrior. There can be no doubt that he enjoyed warfare; and his splendid physique and early training had well fitted him for martial exercises. He was the best rider in the army and the best swimmer in the fleet. Yet he was not like the ordinary fighting bishops of the middle ages, whose sole concession to their sacred calling was to avoid the shedding of blood by using a mace in battle instead of a sword. Absalon never neglected his ecclesiastical duties, and even his wars were of the nature of crusades Moreover, all his martial energy notwithstanding, his personality must have been singularly winning; for it is said of him that he left behind not a single enemy, all his opponents having long since been converted by him into friends.

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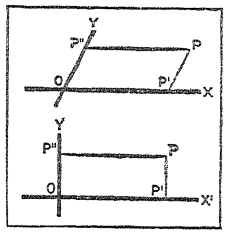
(R. N. B.)

**ABSCESS,** a localized collection of pus in tissue spaces, hollow viscera or body cavities. It is formed as the result of infection with pus-forming (pyogenic) organisms; there is local heat, redness, swelling and pain. The cells die and the centre of the inflammatory mass liquefies to form pus which may break through the wall of the abscess or be emptied by incision. Various names are applied according to the location and the causative organism. The term "cold abscess" designates a localized collection of pus caused by the bacillus of tuberculosis.

(*See* BACTERIAL AND INFECTIOUS DISEASES; INFLAMMATION AND ITS SEQUELS.)

(F. L. A.)

**ABSCISSA.** In Cartesian co-ordinates (*see* CO-ORDINATES) the abscissa of a point ($P$) is the part ($OP'$) of the $X$ axis lying between the origin ($O$) and the point ($P'$) where a line ($PP'$) parallel to the $Y$ axis cuts the $X$ axis In each of the two figures, the line segment $P''P$ is also called the abscissa of $P$. The axis of $X$ ($OX$) is called the axis of abscissas. The term was used in its technical sense by Pietro Mengoli in 1659




**ABSCISSION,** a tearing away, or cutting off; a term used sometimes in prosody for the elision of a vowel before another, and in surgery, especially of the eye, for removal of projections of a diseased cornea; in botany, the separation of spores by elimination of the connection.

**ABSCOND,** to depart in a secret manner, in law, to remove from the jurisdiction of the courts or so to conceal oneself as to avoid their jurisdiction. A person may abscond either for the purpose of avoiding arrest for a crime (*see* ARREST) or for a fraudulent purpose, such as the defrauding of his creditors (*see* BANKRUPTCY).

**ABSENCE,** the fact of being away, either in body or mind. The special occasion roll call at Eton college which the boys attend in their tall hats is called absence. A soldier must get leave of absence before he can be away from his regiment. Seven years' absence with no sign of life either by letter or message is held, by English law, to be presumptive evidence of death

**ABSENTEE OWNERSHIP,** a term to which specialized usage has given different meanings freighted with social and economic implications not inherent in a literal interpretation of the phrase. The earliest such usage identified absentee ownership with proprietors of land who did not reside on their estates, yet demanded and enjoyed incomes from them. This practice, exercised in greater or less degree, has probably always existed where there was private ownership of land Classical writers mention it. It is present in the history of landholding in Hungary, Poland, Russia and other countries of central and eastern Europe, and in parts of the orient, notably India. But students of western thought and institutions know it best through the criticism levelled at the absentee owners among the court nobility of pre-Revolutionary France (though their significance is somewhat minimized by the increased importance given by modern writers to resident country nobles and peasant proprietors); and in connection with Irish lands in the 19th century.

In the main the practice has met popular disfavour, sometimes on economic, often on social and ethical grounds. The basic assumption was that absentee landlords lacked the personal interest and contact believed conducive to the well-being of a tenant population. But in 19th-century England where charges against absentee English landlords who exploited their Irish tenantry brought the subject into the field of economic theory and speculation, the arguments were not all on one side. Some economists defended the practice, not so much as protagonists, as in denial of its responsibility for many of the ills laid at its door. But it was probably the Land Purchase acts and other remedial measures that led to a lessening of interest in the subject by the end of the century.

The first quarter of the 20th century saw the term carried over into the field of business enterprise and industry. A theory developed chiefly among certain U.S economists held that "captains of industry" who, by means of investments managed through corporate organization and financial combines, kept a controlling influence over industrial prices and output while not themselves participating in industry, were the most powerful absentee owners of modern times Thorstein Veblen, social and economic philosopher who pointed up the possible social ills likely to accrue from this practice, did much to enhance the usage of the term though he was not alone in its propagation.

It was the belief of the Veblen school that the cleavage which had grown up between industrial work and business enterprise was responsible for the absentee feature of this type of ownership. And it was in this division that Veblen saw the possibility of all manner of social ills These would, if and when production should outrun markets, lead to action that would in time bear heavily on the underlying population and others engaged in the working processes of industry. Another practice also described as absentee ownership, though of different origin, was that involving the private ownership of public resources The U.S. exploitation of public lands was a flagrant example These ideas were strongly challenged, and they also had stout defense

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**ABSENTEE VOTING, U.S.** was first provided for by state legislation during the Civil War, when 11 Union states permitted men on leave for military duty to vote in the federal election by absentee ballot or by proxy. There were then about 2,000,000 men under arms, of whom about 150,000 voted But although more than three-fourths of the soldiers voted for the re-election of their commander in chief, Pres Abraham Lincoln, their total vote scarcely affected the general outcome

In 1896 a law was passed in Vermont inaugurating the use of the absentee ballot by civilians and five years later a similar measure was passed in Kansas By 1917 citizens of 28 states had acquired the privilege and in 1942 all states except Delaware, Kentucky and New Mexico had absentee voting laws of one kind or another. Legal bases for absentee voting included such duties, businesses or occupations as those of commercial travellers, railroad and marine employees, federal employees and their wives, college and university students and faculties, actors, inmates of veterans' homes and hospitals and members of the regular army. Not all laws, however, were equally comprehensive nor did all apply to military personnel.

There was relatively little interest in the soldier vote during the Spanish-American War or World War I. During the latter, some legislation was discussed, but no action was taken and the war department announced that there would be no voting overseas. It did, however, co-operate with those states which provided machinery for absentee voting within the U.S.

Less than a year after the U.S. entry into World War II, the nation approached the congressional elections of 1942 with an armed force of about 5,500,000 at home and abroad. In an effort to simplify matters for absent soldiers, congress passed a Soldiers Vote law on Sept 16. Mailing of request cards for state ballots was undertaken by the war department and personal registration as well as the poll tax requirements of eight states (Ala., Ark., Ga., Miss., S.C., Tenn., Tex. and Va.) were waived. Nevertheless, the law proved inadequate and of the more than 100,000 who requested ballots, only 28,051 received them and returned them in accordance with their various state law requirements. Efforts to secure more effective legislation were renewed in 1943.

By 1944 there were an estimated 9,225,000 service men and women of voting age scattered throughout the world and a method of ensuring them the vote became a point of controversy between the president and congress. The constitution leaves the qualifications of voters and the machinery for voting (except as modified by the 14th, 15th and 19th amendments) to the various states. Pres. Franklin D. Roosevelt advocated a short federal ballot to which objections were raised on both political and constitutional grounds. First, the Roosevelt-Dewey election promised to be a close contest and the Republicans feared that the great majority of soldiers would vote for their commander in chief, throwing the margin of victory to the Democrats. Second, in spite of the 1942 law, many of the states (especially in the south) protested anew against the encroachment on their traditional rights, since a federal ballot would enfranchise thousands who could not qualify under state laws and requirements such as the poll tax.

Many bills were debated and at last a compromise was arrived at (though not signed by the president who protested its limited character) which became law on March 31. It provided for a short federal ballot for citizens of such states as approved its use, and then, only if the soldier had applied for a state ballot by Sept. 1 and had not received it by Oct. 1. Those eligible in-

cluded members of the army, the navy, the merchant marine and civilian personnel overseas who were in the service of the government or attached to service units, such as members of the Red Cross, the U.S.O., etc. The law called for the creation of a War Ballot commission composed of the secretary of war, the secretary of the navy and the administrator of the War Shipping administration. This body was charged with the printing, distribution and collection of absentee ballots and the mailing of postcard requests for ballots

Twenty states approved the federal ballot, namely: Calif., Conn., Fla., Ga , Me., Md., Mass , Mich., Neb., N H., N J., N M., N C., Okla., Ore , R I , Tex., Utah, Vt and Wash. Use of the federal ballot within the U.S was limited by the law to voters of such states as provided no machinery for absentee soldier voting, but as all 48 states had made such provision by Nov. 1944, the short federal ballot was in effect available only to overseas personnel. Blank ballots were distributed by the War Ballot commission with space for writing in the name or party of candidates for president, vice-president and members of congress. About 4,400,000 absentee ballots, state and federal, were cast by military personnel at home and abroad. In the seven states where data was tabulated separately for civilian and soldier vote the results showed that, despite earlier forecasts, the vote was approximately as close in one category as in the other.

**ABSINTHE,** a highly toxic liqueur or aromatized spirit, the characteristic flavouring matter of which is derived from various species of wormwood (*Artemisia absinthium*). Among the other substances generally employed in its manufacture are angelica root, sweet flag, dittany leaves, star-anise fruit, fennel and hyssop. The Swiss variety has a higher alcoholic strength than the French. The best absinthe contains 70% to 80% of alcohol. It quickly intoxicates, and its deleterious effects are more serious than those of other forms of alcohol. The wormwood acts powerfully upon the nerve centres, and causes delirium and hallucinations, followed in some cases by idiocy. (*See* LIQUEURS.)

**ABSOLUTE.** The term absolute is frequently used in contrast with the terms relative, comparative, conditioned, etc.

**Absolute and Relative, Etc.**—(1) Sometimes the contrast intended is that between what expresses a relationship and what does not. In logic, for instance, a term is described as relative when its function is to indicate some definite relationship in which the object named stands to some other object denoted by the correlative term. Thus teacher is called a relative term because it indicates the relationship in which somebody, say Socrates, stands or stood to somebody else, for instance, Plato, who is consequently designated by the correlative term disciple, or pupil. But a term that indicates no relationship is called absolute. Thus the names Socrates and Plato are called absolute terms because they do not indicate any definite relationship in which Socrates and Plato stood to each other. (2) More commonly the contrast intended is that between what a thing is relatively to something else (or in comparison with certain other things) and what it is in itself (that is, apart from such comparisons), or absolutely. In this sense one sometimes contrasts what is relatively or approximately true with what is absolutely true, or what is comparatively beautiful, or large, or old, etc., with what is absolutely so. (3) Intimately connected with the preceding distinction between absolute and relative, etc., is yet another distinction, which is perhaps the commonest of all. This is the contrast between what is subject to certain reservations or conditions and what is not subject to conditions or reservations. Thus, for example, relative success may mean success under certain difficult circumstances, while absolute success would mean complete success, without any reservations. In this way absolute monarchy means monarchical government not subject to any conditions or reservations, whereas constitutional monarchy means monarchical government subject to certain reservations or restrictions formulated in the constitution of the country. Similarly a system of ethics conceived to be valid for all times under all conditions would be described (by H. Spencer, for instance) as absolute, whereas a system of ethics conceived to be valid only under certain conditions of time, place or circumstance, would be called relative, or local, or temporary, etc (4) The foregoing distinction naturally leads to yet another distinction; namely, that between that which is conditioned by, or dependent on, something else and that which is independent of, or unconditioned by, anything else. In philosophy, absolute [illegible] means independent or unconditioned When certain philosophers speak of absolute truth, or of absolute value, they mean that there are truths, or values, as the case may be, that are objective, independent or self-dependent, and not relative to, or dependent upon, individual thinkers or seekers.

**The Absolute.**—This term owes its great vogue in recent times mainly to the German Idealists (Immanuel von Fichte, Friedrich von Schelling, Georg Hegel, etc.) and their followers. But the main idea which it expresses is already found in Plato; and both the idea and the term were familiar to Thomas Aquinas, Giordano Bruno, Benedictus de Spinoza, and many others, long before the period of German Idealism. The use of the term is intimately connected with the last of the above-mentioned applications of the term absolute (4). Spinoza describes substance (that is, nature, God or the universe) as absolutely infinite, in contrast with its ultimate attributes, which are infinite each in its kind only; and absolutely infinite substance is conceived by Spinoza as the self-existing, independent, unconditional ground of all that is It is the ultimate ground of all reality that is always, or nearly always, meant by the Absolute. But different systems of philosophy hold out different views as regards both the reality and the nature of the Absolute. In Vaihinger's *Philosophy of "As If,"* the Absolute is a fiction. For Hamilton, Henry Mansel and Herbert Spencer the Absolute is the unknown; for Immanuel Kant the Absolute (or Noumenon) is even unknowable. Theists identify the Absolute with God; pantheists. with the universe; Arthur Schopenhauer and Wilhelm Wundt, with will; Henri Bergson. with a life force characterized by creative evolution; Gustav Fechner and Lipsius, with consciousness; Francis Bradley, with experience; Joel, with the potentiality of all that is real; Rudolf Lotze and Josiah Royce, with self-conscious personality; Alexander, presumably with the space-time matrix of all reality. Hegel, whose philosophy is most intimately connected with the conception of the Absolute, identified it with the universal spirit, which by a process of logical or dialectical development takes on one predicate after another until it manifests itself as an objective world in perfect harmony with reason.

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**ABSOLUTE DIFFERENTIAL CALCULUS:** *see* TENSOR ANALYSIS

**ABSOLUTE MUSIC,** a term applied to music of a purely abstract type, devoid of any nonmusical or extra-musical significance, as distinguished from that of the pictorial or descriptive kind known as "programme music" (*q.v.*).

**ABSOLUTE PITCH,** in the language of the physicist, is the position of a tone as determined by its rate of vibration. Among musicians, it signifies that sense, or form of memory, which enables a person to recognize or reproduce any musical tone, as an A or C♯. In this sense, the term is used in contradistinction to relative pitch which concerns itself, for example, with the tonic or the dominant within a given key. The possession of absolute pitch is not considered essential for fine musicianship; notable among composers who were without absolute pitch were Robert Schumann and Richard Wagner. (*See* also PITCH, MUSICAL.)

**ABSOLUTE TEMPERATURE SCALE,** the scale of temperature based on thermodynamics (*q.v.*), also called the Kelvin scale after Lord Kelvin (*q.v.*). The temperature scale derived from the law of expansion of a perfect gas, is identical with this thermodynamical scale. The usual abbreviations for absolute scale are abs., A. or K. Comparing it (approximately) with the centigrade scale, 0° C.=273° A., 100° C.=373° A., thus absolute zero is equivalent to −273° C. (*See* THERMODYNAMICS and THERMOMETRY.)

**ABSOLUTE UNITS,** units of measurement of a physical quantity in terms of the fundamental units of length, mass and

time; the British association selected, as their fundamental units, the centimetre, the gram and the second of mean solar time, and thus formed the C.G.S. system of units. (*See* PHYSICAL UNITS.)

**ABSOLUTION** (religious) denotes the setting of the penitent sinner free from the guilt of his sin, or from the ecclesiastical penalty (excommunication), or from both The authority of the church or its minister to pronounce or refuse forgiveness is implied in II Cor. ii, 5–11, and Acts v, 1–9 (*cf.* James v, 15, 16), and was derived from the tradition of our Lord's teaching; *see* John xx, 23 (in Matt xviii, 18, binding and loosing probably mean forbidding and allowing). In primitive times, when confession of sins was made before the congregation, the absolution was deferred till the penance was completed; and there is no record of the use of any special formula. The penitent was reconciled by imposition of hands by the bishop, with or without the clergy Later the office was usually discharged by priests, and the outward action more and more disused. It became the custom to give the absolution to penitents immediately after their confession and before the penance was performed. Until the middle ages the form of absolution after private confession was of the nature of a prayer, such as "May the Lord absolve thee"; and this is still the practice of the Greek church. But about the 13th century the Roman formula was altered, and the Council of Trent (1551) declared that the form and power of the absolution lay in the words *Ego te absolvo,* etc , and that the accompanying prayers are not essential to it. Of the three forms of absolution in the Anglican Prayer Book, that in the Visitation of the Sick (disused in the church of Ireland and in the United States) runs "I absolve thee," tracing the authority so to act through the church up to Christ: the form in the Communion Service is precative, while that in Morning and Evening Prayer is indicative indeed, but so general as not to imply a decree of absolution.

(W. O. B )

In civil law absolution signifies the acquittal of an accused person on the ground that the evidence has either disproved or failed to prove the charge against him. The term is now little used, except in Scottish law in the forms *assoilzie* and *absolvitor.*

**ABSOLUTISM.** The term absolutism is generally applied to any view or theory that the object under consideration (whatever it may be) is not merely conventional, or subjective, or dependent, or limited in any way, but absolute, that it is real or valid in itself, or objective, or independent, or unrestricted. (*See* ABSOLUTE ) (1) In ethics, absolutism is the view that moral distinctions are not the result of mere arbitrary commands of God, or of human conventions variable according to circumstances, but that they are intrinsically valid, and the same for all human beings, at all times, and in all places. (2) In aesthetics, absolutism is the view that distinctions of beauty and ugliness are not entirely dependent on the subjective feelings of the percipient mind, but that they are objective differences in things themselves, such as the primary qualities of material objects. (*See* QUALITIES ) Absolutism maintains accordingly that aesthetic appreciation should not be regarded as merely a matter of taste about which people must agree to differ (*de gustibus non disputandum*), but that there is an objective or absolute standard of beauty by which aesthetic judgment ought to be guided. The fact that even art specialists are frequently at variance is accounted for by absolutists by the suggestion that individuals vary in their powers of apprehending aesthetic qualities just as they vary in other capacities. (3) In political theory, absolutism denotes a form of government in which the sovereign exercises almost complete power unrestrained by such laws and reservations as characterize what is commonly called constitutional government. (*See* ABSOLUTISM, POLITICAL.)

**ABSOLUTISM, POLITICAL.** In political theory, the term "absolutism" designates a form of government in which the whole power of the state is concentrated in one single individual, the ruler, whose will is the law of the state. All other individuals, members of the community, are subjected to the ruler without participating in his power which for this reason is unlimited and in this sense absolute. For the ruled it means complete lack of individual freedom in the sense of self-determination. It is incompatible with the idea of equality, since justifiable only by the essential difference which is supposed to exist between the ruler and the ruled Political absolutism is synonymous with despotism, dictatorship or autocracy

Its opposite is democracy Here the political power of everybody is necessarily limited by the fact that it must be shared with others and is in this sense relative only In participating in the power of the state, and especially in the creation and application of the law, the individuals are politically free and equal.

In historic reality there is or was no state conforming completely with the type of political absolutism There are only more or less forgoing approximations to this form of government. In the past the most pronounced form of autocracy was the absolute monarchy such as existed in Europe in the 18th century, especially in France under Louis XIV, whose saying, *L'état, c'est moi* (I am the State), is the best-known formulation of its basic idea In the orient, despoties were, during the most diverse periods and among the most diverse peoples, the prevailing political system. In recent times a new form of political absolutism has arisen in the party dictatorship of bolshevism and fascism. In Russia the new form is a product of the socialist revolution that was released by World War I Its intellectual basis is the Marxist theory of class struggle and the dictatorship of the proletariat In reality this dictatorship has become that of a party representing the interests of the proletariat, excluding all other parties, even socialistic ones. The word "bolshevism" was originally applied only to the political creed of the party, which later on exercised dictatorship in Russia; but it has come to designate a type of government In Italy the fascists were a middle-class party that rose to dictatorship in struggle against socialist parties. The word "fascism," like bolshevism, has come to be used as the name for a type of government: the dictatorship of a middle-class party The national socialist state of Germany belonged to this type.

The ruling party in a party dictatorship has itself an autocratic character. Its members are under the absolute rule of the party leader who at the same time is the head of the state. Since bolshevism originally maintained the fiction of a separation of party and state, and further did not have an ideology of "leadership," the leader was for a long time officially the secretary-general of the party only. But in reality there is in this point no essential difference between the two forms of party dictatorship, nor is there an essential difference between so-called party dictatorship and personal dictatorship of an absolute monarch.

Political absolutism corresponds perfectly to philosophical absolutism, meaning by this term the view that there exist absolute values and consequently also absolute truths. The validity of judgments referring to these values is absolute, not relative; objective, not subjective; that is to say, the value judgments are valid, not only relative to, and dependent upon, the judging subject, but for everybody, always and everywhere. Their personal, temporal and territorial spheres of validity are unlimited.

Such a view is possible only under the conscious or unconscious presupposition that there exists an absolute being, unlimited in every respect and, hence, unique. Since value is the function of will, absolute values are conceivable only as emanations of the will of an absolute being. Consequently, the latter must be realized as a supreme normative authority, as the unique and, hence, absolute ruler of the universe. Philosophical absolutism has an immanent tendency toward monotheism.

There is not only perfect parallelism between political and philosophical absolutism; the former has the outspoken inclination to use the latter as an ideological instrument. To justify his unlimited power, the ruler must present himself as directly or indirectly authorized by the only true absolute, the superhuman being, as his descendant or deputy or as inspired by him in a mystical way. Where the political ideology of an autocratic government does not permit recourse to the absolute of an historical religion, as in the case of bolshevism, it assumes itself a more or less religious character by absolutizing its basic value,

the idea of socialism.

Less obvious, but nevertheless not less true, is the parallelism which exists between the opposite of political absolutism—democratism, and the opposite of philosophical absolutism—relativism. To determine the contents of a social order, not according to what is really best for the individuals subject to this order, but according to what these individuals, or their majority, rightly or wrongly believe to be best for them—this consequence of the democratic principle of liberty and equality is justifiable only if there is no absolute answer to the question as to what is the best. It is justifiable only if there is no such thing as an absolute Good (to use a term of Plato, the classical representative of philosophical absolutism and passionate opponent of democracy), or if God, and not (as the democratic sophists said) man, is the measure of all things To let the ignorant majority decide, instead of the only one who by virtue of his divine origin or inspiration has the exclusive knowledge of the absolute Good, is not the most absurd method when it is believed that such knowledge is impossible and that, consequently, no single individual has the exclusive right to enforce his will upon the others In claiming that judgments of value have only relative validity, the basic principle of philosophical relativism implies that opposite value judgments are neither logically nor morally impossible. It is one of the fundamental principles of democracy that everybody has to respect the political opinion of everybody else, since all are equal and free. Tolerance, minority rights, freedom of opinion, freedom of thought, so characteristic of democracy, have no place within a political system based on the belief in absolute values This belief irresistibly leads, and always has led, to a situation in which the one who is supposed to possess the secret of the absolute Good claims to have the right to impose his opinion as well as his will upon the others who are in error, and to be in error is, according to this view, to be wrong. If, however, it is recognized that only relative values are accessible to human knowledge and human will, then it is justifiable to enforce a social order against reluctant individuals only if this order is in harmony with the will of the greatest possible number of equal individuals; that is to say, with the will of the majority. However, it may be that the minority and not the majority is right. Solely because of this possibility (which only philosophical relativism can admit) that what is right today may be wrong tomorrow, the minority must have the chance of expressing freely its opinion and have full opportunity of becoming the majority.

This is the true meaning of that political system which is called democracy, and which may be opposed to political absolutism only because it is political relativism. (H. KN.)

**ABSORPTION OF LIGHT IN SPACE.** This term is used to designate any interference with the propagation of light while it travels through interstellar space.

The possibility that the light of distant stars might be dimmed by absorption on its long path to the earth was mentioned as early as 1720 by Edmund Halley and was discussed by Heinrich Wilhelm Matthias Olbers, Friedrich Georg Wilhelm Struve, Hugo von Seeliger and others during the 19th century. No real evidence of its existence was obtained before the second quarter of the 20th century; after 1930, however, information on this subject accumulated with surprising rapidity.

The earlier studies took it for granted that such absorption, if it existed, would be universal or uniform, and this erroneous expectation has undoubtedly retarded the discovery. The actual observational data show that absorption of light in space is caused by interstellar matter, highly rarefied nebulous matter, irregularly spread between the stars through certain parts of our stellar system while in other parts of the universe the transparency of space is practically perfect. The problem of space absorption is thus intimately related to that of nebulae and interstellar matter; it forms the main avenue of approach to the investigation of the latter.

The observed phenomena of interstellar absorption and the knowledge of interstellar matter gained therefrom will be presented under the following headings: (1) general absorption, (2) change of colour by absorption, (3) interstellar spectral lines, (4) nature and distribution of interstellar matter

**General Absorption.**—The light radiated by a star spreads in all directions, and in a perfectly transparent space the star's apparent brightness must be inversely proportional to the square of its distance from the observer; but if the light suffers an absorption in space the apparent brightness decreases more rapidly with distance than by the inverse square law A loss of light by interstellar absorption may thus be detected if, in addition to the apparent brightness of a star, we can also determine its distance and its true luminosity (brightness when seen at unit distance) The last two data, however, are difficult to obtain for stars sufficiently far away to show an appreciable absorption effect

The first successful test of this kind was made by R J Trumpler in 1930 in a study of galactic star clusters The angular diameter of each of these star groups furnished an estimate of its distance, while the luminosities of its stars could be inferred from their spectra. In the more distant clusters (5,000 to 15,000 light years) the observed brightness of the cluster stars was found considerably less than that calculated by the inverse square law. Over a distance of 10,000 light years the loss of light (photographic) by space absorption was on the average about 2 magnitudes or 84%. A similar result was later obtained by A. Joy and R. E Wilson from a study of faint Cepheid variables.

The existence of local absorption effects in the Milky Way had already been recognized by E E Barnard and M Wolf at the end of the last century. Their excellent Milky Way photographs revealed numerous dark, nearly starless patches in the midst of densely crowded star fields. They interpreted these formations as dark nebulae—local clouds of absorbing matter which obscure the stars behind them. When the numbers of stars of different magnitudes are counted in the obscured region and in the surrounding normal star field, the distance and absorption of the cloud can be found by statistical analysis Several of the most conspicuous dark clouds have been investigated by this method and all evidence seems to indicate that they are merely local concentrations in the general stratum of interstellar matter.

**Change of Colour by Absorption.**—The sun appears red when it is near the horizon before sunset because its blue light of short wave lengths has been mostly lost by scattering in the earth's atmosphere, while the longer waves of red light have been more readily transmitted. In a similar way, if absorption of light in space affects some colours or wave lengths more than others, the colour (or mixture of colours) of distant stars will be changed

Since a star radiates very nearly like a perfect radiator (black body), its true colour is determined by the temperature of its luminous surface. The latter can be estimated rather closely from the spectral class, that is from the intensities of the various dark absorption lines in its spectrum. The difference between the observed colour of a star and its true colour as inferred from its spectral class is called the colour excess. Extensive studies of colour excess in galactic star clusters and of high temperature stars show conclusively that distant stars in the Milky Way are considerably reddened by interstellar absorption, and that the latter is nearly inversely proportional to the wave length According to physical theory a loss of light of this kind is produced when light is scattered by small solid particles. Interstellar space seems to be permeated by a thin haze of fine cosmic dust.

**Interstellar Spectral Lines.**—When the light of a star is spread by the spectroscope into a continuous band of rainbow colours, this band is found to be interrupted by numerous dark lines. Such spectral lines are due to absorption of certain wave lengths by the atoms or molecules of any gases through which the light emitted by the star's luminous surface passes before reaching the observer.

Most of the lines observed in stellar spectra originate in the atmosphere of the star (star lines), a few in the earth's atmosphere (telluric lines), and some, according to recent evidence, are absorbed on the passage of the light through space between the star and the earth (interstellar lines). The existence of these latter lines proves that interstellar matter also contains free atoms and molecules, and these may be said to form an extremely rare-

fied interstellar gas

The main difficulty is that of distinguishing interstellar lines from star lines. This is possible, for instance, in the case of binary systems where two stars are rapidly revolving around their centre of gravity. The star lines in the spectrum of one of these stars will be alternately shifted toward the violet and the red end of the spectrum (Doppler shift) as the star approaches or recedes from the observer Interstellar matter, of course, takes no part in such orbital motion and its lines remain stationary

In general, interstellar lines may also be recognized by the fact that they are stronger in the spectra of distant Milky Way stars than in the spectra of relatively near stars of the same spectral class

The most important interstellar lines identified are those due to atoms of calcium, sodium, potassium, titanium, iron and to the molecules CH and CN. It is, however, probable that most of the common elements as well as free electrons are contained in the interstellar gas although some of the constituents do not reveal their presence as readily as others

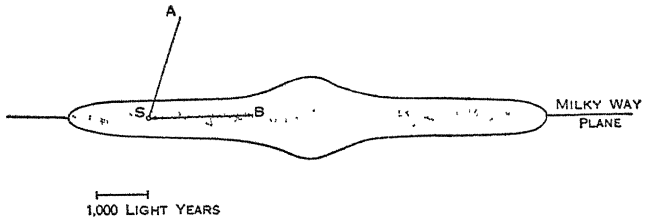
**Nature and Distribution of Interstellar Matter.**—The observed effects of space absorption lead to the conclusion that the space between the stars is not completely empty but contains some matter consisting of small solid particles as well as atoms and molecules.

The solid particles may be of various sizes, but those which produce most of the scattering must be very small with diameters of 0 1 to 10 microns (25,000 microns = 1 in ). Nothing is known about their chemical composition except that they are probably nonmetallic.

It is difficult to give an adequate idea of the extremely rarefied state of interstellar matter. On the average, one cubic mile of such matter would weigh less than $\frac{1}{100,000,000}$ gr ; it would contain a few hundred microscopic dust particles and about as many molecules and atoms as are found in $\frac{1}{100,000}$ cu.cm. of air. The space between the stars, however, is so large that the total mass of interstellar matter is probably not much less than the mass contained in the stars. Perhaps these interstellar particles are debris lost by the stars; perhaps they constitute the primordial matter from which stars are born. In any case they form an important feature of our stellar system and in many of the external galaxies the presence of such dark matter is also quite noticeable.

The general distribution of interstellar matter in relation to our stellar system is illustrated in the figure. This system is of a highly flattened shape somewhat like a circular disk or lens, and the plane of this disk is outlined on the celestial sphere by the circle of the Milky Way. Interstellar matter seems to be confined to a relatively thin layer stretching along the central plane of the system. Outside of this layer we find practically no absorbing matter and the vast spaces between our system and other galaxies appear to be of perfect transparency.

When observing from the solar system S (fig ) in the direction A, at a considerable angle from the Milky Way, the line of sight has only a short path through the absorbing layer, and we can see very distant objects such as external galaxies with little interference. In the direction of the Milky Way (direction B), the light from distant stars is obstructed all along its way and shows heavy absorption effects. This peculiar arrangement of the absorbing medium has the consequence that we can see external galaxies millions of light years away while large parts of our own stellar system are obscured from our view and we have so far not even been able to penetrate to the centre of our galaxy.




SPACE DISTRIBUTION OF INTERSTELLAR MATTER

The full line shows a cross cut through the lens-shaped system containing the stars; the position of our sun is marked by S. The dotted area indicates the region where highly rarefied cosmic dust and interstellar gas are irregularly spread between the stars. Outside of this layer, space is of practically perfect transparency

The distribution of interstellar matter through this general layer, however, is extremely irregular. The cosmic dust seems to have the tendency to accumulate in numerous local clouds large or small with concentrations sometimes exceeding ten times the average How closely the distribution of the interstellar gas follows the irregularities of the cosmic dust is as yet uncertain.

While on the one hand absorption of light in space is an important source of information concerning interstellar matter, it is on the other hand a serious obstacle in any attempt to map the structural features of our stellar system by statistical studies of star distribution. The technique of taking photographs by red or infra-red light, less subject to scattering by cosmic dust, may, however, offer a means for penetrating to the more distant parts of our galaxy.

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**ABSORPTION SPECTRUM:** *see* BAND SPECTRUM; LIGHT; QUANTUM MECHANICS; SPECTROSCOPY.

**ABSTEMII,** a name formerly given to such persons as could not partake of the cup of the Eucharist on account of their aversion to wine (Lat. *abs,* "away from"; *temetum,* "intoxicants"). In modern times many total abstainers, holding that the use of intoxicants is to be condemned absolutely, communicate in the unfermented "juice of the grape," sometimes also alleging that the wine used by Christ and his disciples at the Last Supper was unfermented.

**ABSTINENCE,** the fact or habit of refraining from anything, usually from indulgence of the appetite. A "total abstainer" is one who takes the pledge to abstain from alcoholic liquor (*see* TEMPERANCE). Abstinence in the Christian Church is a moderate form of fasting (*q.v.*).

"Abstinence" was also a term in economics, now fallen into disuse, applied to the postponement or sacrifice of present satisfaction for the sake of future gain.

It remains true that no person will save except for the purpose of securing some future advantage for himself or for others. As Frank Taussig puts it, "present resources will not be cancelled for future resources unless some inducement be offered." This is true equally of individual or of communal saving; thus, a Collectivist or Socialist government could only provide capital for the prosecution of industry or for future social satisfactions by drafts upon current income, *i.e.,* by performing an act of national abstinence. (*See* ECONOMICS.)

**ABSTRACT** and **ABSTRACTION.** The term abstract is sometimes used as a noun to denote a summary or digest of a document. Such an abstract is usually obtained by selecting what is essential and omitting the rest. Speaking generally, the process of abstraction is usually a process of selection of some part or aspect of a complex whole, and of consequent neglect of the rest. The result of such a process of "withdrawal" (in the twofold sense of selecting a part and neglecting the rest) is commonly described as abstract.

In logic, *e g.,* abstract terms are distinguished from concrete terms, the latter denote objects consisting of a whole complex of attributes and standing in various relations, whereas the former designate some quality or relation isolated or abstracted from its concrete context. For instance, "motor" and "relative" are concrete terms, whereas "motion" and "relationship" are abstract terms. But there are degrees of abstraction—the selection may be less or more restricted, and the consequent neglect more or less extensive. This may be readily seen if one passes in review such a series of terms as, say, "the horse that won the Derby in 1927," "race horse," "horse," "quadruped," "animal," "life." Of these terms only the last would be called abstract, but really all the

terms in the series except the first are obtained by abstraction. In fact all general terms, or common nouns, are the result of abstraction. That is why some of the earlier logicians and psychologists applied the epithet *abstract* to what are now usually called general concrete terms It is just a matter of convenience and convention that only the more abstract terms are now called *abstract,* the less abstract terms being called *general*

In the past too much stress used to be laid on the negative side of abstraction; that is, on the mere neglect of certain parts or aspects of the concrete whole. It is now realized more fully that the process is mainly positive in character. It is a process of positive selection, not merely one of omission, though of course it involves omission.

The relative stress on the positive and the negative sides of the process of abstraction really varies considerably. When the process is merely spontaneous, or not deliberate, the negative character of abstraction is probably more prominent; when it is deliberate (that is, a process of voluntary attention), the positive phase is the more marked.

Abstraction is of great importance for all real knowledge, especially for science and philosophy. The aim of all scientific knowledge is the discovery of laws expressing the relation or correlation between various aspects of reality, such as mass and gravitation, volume and pressure or temperature and volume; and it is by processes of abstraction that these phases of reality are isolated and followed up (A. Wo.)

**ABSTRACT OF TITLE,** in law, a digest or epitome of the various instruments and events under, and in consequence of, which the vendor or mortgagor of an estate derives his title thereto. The system of registration has much affected the necessity for this abstract's being prepared or used. (*See* also LAWS RELATING TO REAL PROPERTY AND CONVEYANCING )

**ABT, FRANZ** (1819–1885), German composer, was born at Eilenburg, Saxony, and died at Wiesbaden. His songs and part-songs enjoyed an extraordinary vogue throughout the world in the middle of the 19th century, and are still popular.

Abt was kapellmeister at Bernburg in 1841, at Zurich in the same year and at Brunswick from 1852 to 1882, when he retired to Wiesbaden.

**ABU,** a mountain of central India, situated within the Rajputana state of Sirohi. It is an isolated peak of the Aravalli range, being completely detached from that chain by a narrow valley 7 mi. across, in which flows the western Banas. It rises from the surrounding plains of Marwar like a precipitous granite island, its various points ranging from 4,000 to 5,646 ft. The elevations and platforms of the mountain are covered with elaborately sculptured shrines, temples and tombs. On the top of the hill is a small round platform containing a cavern, with a block of granite, bearing the impression of the feet of Data-Bhrigu, an incarnation of Vishnu.

The two principal temples, at Dilwarra, about the middle of the mountain, are built of white marble, and are pre-eminent alike for their beauty and as typical specimens of Jain architecture in India.

The more modern of the two was built by two brothers, rich merchants, between the years 1197 and 1247, and for delicacy of carving and minute beauty of detail stands almost unrivalled, even in that land of patient and lavish labour.

The other was built by Vimala, a local governor, apparently about A.D. 1032; simpler and bolder in style, it is one of the oldest, as well as one of the most complete, examples of Jain architecture known. The principal object within the temple is a cell lighted only from the door, containing a cross-legged seated figure of the god Parswanath The portico is composed of 48 pillars, the whole enclosed in an oblong courtyard about 140 ft. by 90 ft., surrounded by a double colonnade of smaller pillars, forming porticos to a range of 52 cells, each of which is occupied by an image of Parswanath.

The whole interior is magnificently ornamented.

Abu was the summer residence of the governor-general's agent for Rajputana, and is a place of resort for Europeans in hot weather. The annual mean temperature is about 70°, rising to 90° in April; but the heat is never oppressive. The annual rainfall is about 68 in.

**ABU BEKR,** properly ABU BAKR (*c.* 573–634), the first of the Mohammedan caliphs (*see* CALIPHATE), the son of Abu Kohāfa, of the Taim clan of the tribe of Quraish at Mecca. His original name is unknown, since on conversion to Islam he took the name of 'Abdullah. *Abu Bekr* ("father of the camel-foal") is an epithet, also of unknown origin and sometimes mistakenly rendered "father of the virgin" (*bikr*), in reference to his daughter Ayesha (A'isha), the young wife of the prophet Mohammed. He was one of the earliest of Mohammed's converts and spent the considerable wealth which he had acquired by trade in the service of the new religion and in ransoming slaves. His firm belief in Mohammed and his teachings won for him the appellation of al-Siddīk ("the faithful") In his personal relationship to the prophet he showed the deepest veneration and unswerving devotion. When Mohammed fled from Mecca to Medina (622), Abu Bekr was his sole companion; and Abu Bekr remained constantly with him till his death. During his last illness the prophet indicated Abu Bekr as his successor by appointing the latter to lead the congregation in public prayers.

The choice was ratified by the chief companions of the prophet at Medina and ultimately confirmed, although it was disputed by Ali, Mohammed's son-in-law. After a time Ali submitted, but the difference gave rise to the controversy which divides Moslems into Sunnites and Shi'ites, the latter supporting the claims of Ali.

Abu Bekr had scarcely assumed his new position (632), under the title of *khalīfat rasūl-illāh* ("successor of the apostle of God") when he was called to suppress a rising of the tribesmen of Hejaz and Nejd against the political control of Medina and the payment of *zakat* ("almstax," or tribute). The troops of Medina encountered strong opposition from several quarters but defeated the rebels in a series of engagements, the severest struggle being that with the "false prophet" Mosailima in Nejd, who was finally overcome by Khālid in the battle of Akraba. The reconverted tribesmen were called up to join the expeditions into Iraq under Khālid and toward Palestine and Syria under different commanders. After the hard-won victory over Mosailima, Omar, fearing that Mohammed's revelations might be forgotten when those who had heard them were removed by death, induced Abu Bekr to put them into a written form The completed record was deposited with Omar's daughter Hafsa (one of the wives of Mohammed) and furnished most of the materials out of which the Koran was prepared. Abu Bekr died on Aug. 23, 634, probably from natural causes although one tradition speaks of poison. He is said to have indicated Omar as his successor.

*See* Sir W Muir, *The Caliphate,* rev. ed. (Edinburgh, 1924); L. Caetani, duke of Sermoneta, *Annali dell' Islam,* vol. ii and iii (Milan, 1907–10). (H. A. R G.)

**ABU HAMED,** a town of the Anglo-Egyptian Sudan on the right bank of the Nile, 345 mi. by rail N. of Khartum, and near the head of the fourth cataract. It stands at the centre of the great S-shaped bend of the Nile, and from it the railway to Wadi Halfa strikes straight across the Nubian desert, a little west of the old caravan route to Korosko. A branch railway, 138 mi. long from Abu Hamed, goes down the right bank of the Nile to Kareima in the Dongola district.

The town is named after a celebrated sheikh buried there, by whose tomb travellers crossing the desert formerly used to deposit all superfluous goods, the sanctity of the saint's tomb ensuring their safety.

During the advance on Khartum in 1897, a sharp action was fought there, the troops under Gen. George Hunter routing the Dervishes (Aug. 7, 1897).

**ABŪ HANĪFA AN-NU'MAN IBN THABIT,** Mohammedan canon lawyer, was born at Kufa in A.H. 80 (A.D. 699) of non-Arab, and probably Persian, parentage. Few events of his life are known to us with any certainty. He was a rich silk-dealer, lectured at Kufa upon canon law (*fiqh*) and was a consulting lawyer (*mufti*), but refused steadily to take any public post. When al-Mansūr, however, was building Baghdad (145–149) Abū Hanīfa was one of the four overseers whom he appointed over the crafts-

men. In A.H. 150 (A.D. 767) he died there. A persistent but apparently later tradition asserts that he died in prison after a severe beating, because he refused to obey al-Mansūr's command to act as a judge (cadi, *qādi*). This was to avoid a responsibility for which he felt unfit—a frequent attitude of more pious Muslims.

For many personal anecdotes *see* de Slane's transl of Ibn Khallikan iii. 555 ff., iv. 272 ff. He was buried in eastern Baghdad, where his tomb still exists, one of the few surviving sites from the time of al-Mansūr, the founder.

*See* C Brockelmann, *Geschichte,* i, 169 ff , Nawawi's *Biogr. Dict.* pp 698–770; Ibn Hajar al-Haitami's *Biography,* publ. Cairo, A.H 1304; legal bibliography under ISLAMIC LAW.

**ABU KLEA,** a halting-place for caravans in the Bayuda desert, Anglo-Egyptian Sudan. It is on the road from Merawi to Metemma and 20m. north of the Nile at the last-mentioned place. Near this spot, on Jan. 17, 1885, a British force marching to the relief of Gen. Gordon at Khartum was attacked by a greatly superior force of Mahdists, who were repulsed On the 19th, when the British force was nearer Metemma, the Mahdists renewed the attack, again unsuccessfully. Sir Herbert Stewart, the commander of the British force, was mortally wounded on the 19th, and among the killed on the 17th was Col F G Burnaby.

**ABU-L-'ALA UL-MA'ARRI** (973–1057), Arabian poet and letter-writer, belonged to the South Arabian tribe Tanukh, a part of which had migrated to Syria before the time of Islam. He was born in 973 at Ma'arrat un-Nu'mān in Syria. In 1007 he visited Baghdad, where he was admitted to literary circles, recited in the academies and mosques, and made the acquaintance of men to whom he addressed some of his letters later. In 1009 he returned to Ma'arra, where he spent the rest of his life in teaching and writing

Of his works the chief are two collections of his poetry and two of his letters. The earlier poems up to 1029 have been published in Bulaq (1869), Beirūt (1884) and Cairo (1886), under the title of *Saqt uz-Zand.* The poems of the second collection, known as the *Luzūm ma lam yalzam,* or the *Luzūmiyyāt,* are written with the difficult rhyme in two consonants instead of one, and contain the more original, mature, and somewhat pessimistic thoughts of the author on mutability, virtue, death, etc. They have been published in Bombay (1886) and Cairo (1889).

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**ABU-L-'ATAHIYA** (Abū Ishāq Ismā'īl ibn Qāsim al-'Anazī) (748–828), Arabian poet, was born at 'Ain ut-Tamar in the Hejāz near Medina. His ancestors were of the tribe of 'Anaza. His life was spent in Kufa and in Baghdad, where he died in 828 in the reign of al-Ma'mūn. The poetry of Abū-l-'Atāhiya is notable for its avoidance of the artificiality almost universal in his days. The older poetry of the desert had been constantly imitated up to this time, although it was not natural to town life. Abū-l-'Atāhiya was one of the first to drop the old qasīda (elegy) form. He is one of the earliest philosophic poets of the Arabs. Much of his poetry is concerned with the observation of common life and morality, and sometimes is pessimistic. Naturally, in the circumstances, he was strongly suspected of heresy

His poems (*Diwān*) with life from Arabian sources have been published at the Jesuit Press in Beirūt (1887, 2nd ed. 1888). On his position in Arabic literature *see* W. Ahlwardt, *Diwān des Abu Nowas* pp. 21 *et seq.* (Greifswald, 1861); A. von Kremer, *Culturgeschichte des Orients,* vol. ii. pp. 372 ff. (Wien, 1877).

**ABULFARAJ** (Abū-l-Faraj 'Alī ibn ul-Husain ul-Isfahani) (897–967), Arabian scholar, was a member of the tribe of the Quraish (Koreish) and a direct descendant of Marwān, the last of the Omayyad caliphs. He was thus connected with the Omayyad rulers in Spain, and seems to have kept up a correspondence with them and to have sent them some of his works. He was born in Isfahān, but spent his youth and made his early studies in Baghdad. He became famous for his knowledge of early Arabian antiquities His later life was spent in various parts of the Muslim world, in Aleppo with Saif-ud-Daula (to whom he dedicated the *Book of Songs*), in Rai with the Buyid vizier ibn 'Abbād and elsewhere. In his last years he lost his reason. In religion he was a Shiite Although he wrote poetry, also an anthology of verses on the monasteries of Mesopotamia and Egypt, and a genealogical work, his fame rests upon his *Book of Songs* (*Kitāb-ul-Aghāni*), which gives an account of the chief Arabian songs, ancient and modern, with the stories of the composers and singers. It contains a mass of information as to the life and customs of the early Arabs, and is the most valuable authority we have for their pre-Islamic and early Muslim days A part of the *Book of Songs* was published by J. G L Kosegarten with Latin translation (Greifswald, 1840). The text was published in 20 vols at Bulaq in 1868 Vol. xxi. was edited by R. E. Brunnow (Leyden, 1888). A volume of elaborate indices was edited by I Guidi (Leyden, 1900), and a missing fragment of the text was published by J. Wellhausen in the *Zeitschrift der deutschen morgenlandischen Gesellschaft,* vol. 50, pp. 146 ff For his life *see* M'G de Slane's translation of Ibn Khallikan's *Biographical Dictionary,* vol. ii. pp. 249 ff. (G. W. T.)

**ABULFARAJ** (13th century): *see* BAR-HEBRAEUS.

**ABUL FAZL** (ăb-ul fahzl) (1551–1602), vizier and historiographer of the Mogul emperor, Akbar, wrote the *Akbar Nameh* or "Book of Akbar" in Persian. It consists of two parts, and is a history of Akbar's reign and the *Ain-i-Akbari,* or "Institutes" of Akbar, giving an account of the constitution, religion and administration of the empire. Akbar was murdered at the instigation of Prince Selim, afterwards Jahangir, who was jealous of the vizier's influence.

A translation of the *Ain-i-Akbari* (Calcutta, 1783–86), by Francis Gladwin, is now exceedingly rare. There is a modern translation (Calcutta, 1873, 1891, 1894): vol. i. by H. Blockmann, vols. ii. and iii. by H. S. Jarrett.

**ABULFEDA** (Abū-l-Fidā' Ismā'īl ibn 'Ali 'Imād-ud-Dnī) (1273–1331), Arabian historian and geographer, was born at Damascus, whither his father Malik ul-Afdal, brother of the prince of Hamah, had fled from the Mongols. He was a descendant of Ayyūb, the father of Saladin. In 1285 he was present at the assault of a stronghold of the knights of St. John, and he took part in the sieges of Tripoli, Acre and Qal'at ar-Rūm. In 1298 he entered the service of the Mameluke Sultan Malik al-Nāsir and in 1310 became governor of Hamah. In 1312 he became prince with the title Malik us-Sālih, and in 1320 received the hereditary rank of sultan with the title Malik ul-Mu'ayyad. For more than twenty years altogether he reigned in tranquillity and splendour, devoting himself to the duties of government and to the composition of the works to which he is chiefly indebted for his fame. He was a munificent patron of men of letters, who came in large numbers to his court. He died in 1331.

BIBLIOGRAPHY.—His chief historical work is *An Abridgment of the History of the Human Race,* annals extending from the creation to the year 1329 (Constantinople, 1869). Various translations of parts of it exist. His *Geography* is founded on the works of his predecessors, and so ultimately on the work of Ptolemy. Parts of the work were published and translated as early as 1650 (*cf.* Carl Brockelmann's *Geschichte der Arabischen Litteratur,* Berlin, 1902, vol. ii. pp. 44–46). The text of the whole was published by M. G. de Slane and M. Reinaud (Paris, 1840), and a French translation with introduction by M. Reinaud and Stanislas Guyard (Paris, 1848–83).

**ABU'L KASIM MANSUR:** *see* FIRDOUSI.

**ABŪ-L-QĀSIM** [Khalaf ibn 'Abbās uz-Zahrāwi], Arabian physician and surgeon, generally known in Europe as ABULCASIS, flourished in the tenth century at Cordova as physician to the caliph 'Abdur-Rahmān III. (912–961).

A part of his compendium of medicine was published in Latin as *Liber theoricae nec non practicae Alsaharavii* (Augsburg, 1519). His manual of surgery was published at Venice in 1497, at Basle in 1541, and at Oxford *Abulcasis de Chirurgia arabice et latine cura Johannis Channing* (2 vols. 1778).

For his other works *see* Carl Brockelmann, *Geschichte der arabischen Literatur* (Weimar, 1898), vol. 1. pp. 239–240; M. Neuberger, *History of Medicine,* vol. I (1910).

**ABŪ 'L WAFĀ** or ALBUZDSCHANI (940–998), Arab astronomer and mathematician, was born at Buzdschan in Khurāsān, and was one of the most learned men of his day. A passage in his *Almagest* is held by some to indicate that he had noted inequalities in the moon's motion, later described as variation. He translated and commented on the works of the Greek mathematicians, and made an exhaustive commentary on Diophantus, but these writings are lost. The existing book in 12 chapters of geometrical constructions in a Persian translation is not his, but appears to be derived from an account of his lectures drawn up by one of his pupils. Abû 'l Wafā introduced the trigonometrical functions and constructed tables of tangents and co-tangents.

*See* Woepcke in *Journal Asiatique,* Feb. and March, 1855.

**ABUNDANTIA,** Roman goddess, the personification of prosperity and good fortune. On the coins of the later Roman emperors she is frequently represented holding a horn of plenty and distributing grain and money She may be compared with Domina Abundia (O. Fr. *Dame Habonde, Notre Dame d'Abondance*), a beneficent fairy, who brought plenty to those whom she visited (Grimm, *Teutonic Mythology,* i. 286–7).

**ABU NUWAS** (Abū 'Alī Hal-asan ibn Hāni'al-Hakamī) (*c.* 756–810), Arabian poet, was born in al-Ahwāz, probably about 756. His mother was a Persian, his father a soldier, a native of Damascus. He is said to have spent a year with the Arabs in the desert to gain purity of language. Settling in Baghdad he enjoyed the favour of Harūn al-Rashīd and al-Amīn, and died there, probably about 810. Abū Nuwās is recognized as the greatest Arab poet of his time Genial, cynical, immoral, he drew on all the varied life of his time for the material of his poems. In his wine-songs especially the manners of the upper classes of Baghdad are revealed. He was one of the first to ridicule the set form of the *qasīda* (elegy) as unnatural, and has satirized this form in several poems

*See* I. Goldziher, *Abhandlungen zur Arabischen Philologie* (Leyden, 1896), i. pp. 145 ff. His poems were collected by several Arabian editors. One such collection (the MS. of which is now in Vienna) contains nearly 5,000 verses. His collected poems (*Diwān*) have been published in Cairo (1860), in Beirūt (1884) and an edition by Isma 'īl al-Nabhānī (Cairo, 1904). The wine-songs were edited by W. Ahlwardt under the title *Diwān des Abu Nowas.* 1. *Die Weinlieder* (Greifswald, 1861).

**ABU SIMBEL** or **IPSAMBUL,** the name of a group of temples of Rameses II. (*c.* 1250 B C.) in Nubia, on the left bank of the Nile, 56m. by river south of Korosko. They are hewn in the sandstone cliffs at the riverside, and are three in number. The principal temple, begun by Seti and completed by his son, is probably the greatest and most imposing of all rock-hewn monuments. It was discovered by Burckhardt in 1812 and opened by Belzoni in 1817; the front has been cleared several times, but the sand is always pressing forward from the north end. The hillside was recessed to form the façade, backed against which four immense seated colossi of the king, in pairs on either side of the entrance, rise from a platform or forecourt reached from the river by a flight of steps The colossi are 65ft. in height, of nobly placid design, and are accompanied by smaller figures of Rameses' queen and their sons and daughters; behind and over them is the cornice, with the dedication below a long row of apes, standing in adoration of the rising sun. The temple is dedicated primarily to the solar gods Amenra of Thebes and Raharakht of Heliopolis, the true sun god; it is oriented to the east so that the rays of the sun in the early morning penetrate the whole length of two great halls to the innermost sanctuary and fall upon the central figures of Amenra and Rameses, which are there enthroned with Ptah of Memphis and Raharakht on either side. The interior of the temple consists of a series of halls, penetrating for 185ft. into the solid rock and decorated with coloured sculpture of fine workmanship and in good preservation; some of the scenes are of religious import (amongst them Rameses as king making offerings to himself as god), others illustrate war in Syria, Libya and Ethiopia: another series depicts the events of the famous battle with the Hittites and their allies at Kadesh, in which Rameses saved the Egyptian camp and army by his personal valour Not the least important feature of the temple belongs to a later age when some Greek, Carian and Phoenician soldiers of one of the kings named Psammetichus (apparently Psammetichus II., 594–589 B C) inscribed their names upon the two southern colossi, doubtless the only ones then clear of sand. These graffiti are of the highest value for the early history of the alphabet, and as proving the presence of Greek mercenaries in the Egyptian armies of the period. The upper part of the second colossus (from the south) has fallen; the third was repaired by Sethos II. not many years after the completion of the temple. A small temple, immediately to the south of the first, is believed to have had a built antechamber: it is the earliest known example of a "birth chapel," such as was usually attached to Ptolemaic temples for the accommodation of the divine mother-consort and her son The third and northernmost temple, separated from the others by a ravine, is on a large scale; the colossi of the façade are six in number and 33ft. high, representing Rameses and his queen Nefrēre, who dedicated the temple to the goddess Hathōr.



THE COLOSSAL STATUES OF RAMESES II AT ABU SIMBEL ARE 65FT. HIGH AND ARE ACCOMPANIED BY SMALLER STATUES OF THE MEMBERS OF HIS FAMILY

**ABŪ TAMMĀM** (Habīb ibn Aus) (807–846), Arabian poet, was born in Jāsim (Josem), a place to the north-east of the Sea of Tiberias or near Manbij (Hierapolis). He died in Mosul Abū Tammām is best known as the compiler of the collection of early poems known as the *Hamāsa* (*q v*). Two other collections of a similar nature are ascribed to him. His own poems have been somewhat neglected owing to the success of his compilations. His poems (*Diwān*) were published in Cairo (A D. 1875).

*See* Life in Ibn Khallikan's *Biographical Dictionary,* trans. by M'G. de Slane (Paris and London, 1842), vol. i. pp. 348 ff.; and in the *Kitāb ul-Aghāni* (Book of Songs) of Abulfaraj (Bulaq, 1869), vol. xv pp. 100–108, also D. S. Margoliouth "Indices to the Diwan of Abu Tammam" in the *Journal* of the Royal Asiatic Society (1905).

**ABUTILON** (from the Arabic *aubūtīlūn,* a name given by Avicenna to this or an allied genus), a genus of tropical shrubs of the family Malvaceae (mallows), having about 100 widely distributed species, often called flowering maple and Chinese bell-flower. They are free-growing, with showy bell-shaped flowers, and are favourite greenhouse plants.

They are grown as summer bedding plants but will stand no frost and are readily propagated from spring- or autumn-rooted cuttings.

Many hybrids have variegated foliage.

**ABUTMENT,** a construction in masonry designed to receive and resist the lateral pressure of an arch, vault or strut. When part of a wall it is termed a buttress (*q v.*).

**ABU UBAIDA** (Ma'mar ibn ul-Muthannal) (728–825), Arabian scholar, was born a slave of Jewish-Persian parents in Basra. In 803 he was called to Baghdad by Harūn al-Rashid. He died in Basra. He was one of the most learned and authoritative scholars of his time in the Arabic language, antiquities and stories. The titles of 105 of his works are mentioned in the *Fihrist,* and his *Book of Days* is the basis of parts of the history of ibn al-Athīr and of the *Book of Songs,* but nothing of his (except a song) seems to exist now in an independent form.

BIBLIOGRAPHY —See *Life* in ibn Khallikān's *Biographical Dictionary*, trans by M'G de Slane (1842), vol. III., pp 388–398, also I. Goldziher's *Muhammedanische Studien* (Halle, 1888), vol I., pp 194–206

**ABYDOS,** ancient town of Mysia, Asia Minor, on the Hellespont, here scarcely a mile broad Probably originally a Thracian town, it was afterwards colonized by Milesians Here Xerxes crossed the strait on his bridge of boats when he invaded Greece. Abydos is celebrated for its vigorous resistance to Philip V of Macedon (200 B C ), and is famed in story for the loves of Hero and Leander Until late Byzantine times the toll station of the Hellespont, its importance was transferred to the Dardanelles (*q v* ), after the building of the "Old Castles" by Sultan Mohammed II (*c* 1456)

**ABYDOS,** one of the most ancient cities of Upper Egypt, about 7m west of the Nile in lat 26° 10′ N (railway station Al-Baliana) The Egyptian name was *Abdu,* "the hill of the symbol or reliquary" in which the sacred head of Osiris was preserved Thence the Greeks named it Abydos, like the city on the Hellespont; the modern Arabic name is *Arabet el Madfuneh.* The history of the city begins in the late prehistoric age, it having been founded by the pre-Menite kings whose town, temple and tombs have been found there The kings of the 1st dynasty, and some of the 2nd dynasty, were also buried here, and the temple was renewed and enlarged by them Great forts were built on the desert behind the town by three kings of the 2nd dynasty. The temple and town continued to be rebuilt at intervals down to the times of the 30th dynasty, and the cemetery was used continuously In the 12th dynasty a gigantic tomb was cut in the rock by Senwosri (or Senusert) III Seti I. in the 19th dynasty founded a great new temple to the south of the town in honour of the ancestral kings of the early dynasties; this was finished by Rameses II , who also built a lesser temple of his own. Mineptah added a great Hypogeum of Osiris to the temple of Seti. The latest building was a new temple of Nekhtnebf in the 30th dynasty

The worship here was of the jackal god Upuaut (Ophois, Wepwoi), who "opened the way" to the realm of the dead, increasing from the 1st dynasty to the time of the 12th dynasty and then disappearing after the 18th Anher appears in the 11th dynasty; and Khentamenti, the god of the western Hades, rises to importance in the middle kingdom and then vanishes in the 18th The worship here of Osiris in his various forms begins in the 12th dynasty and becomes more important in later times, so that at last the whole place was considered as sacred to him.

The temples successively built here on one site were nine or ten in number, from the 1st dynasty, to the 26th dynasty (500 B.C ). The first was an enclosure, about 30 x 50ft., surrounded by a thin wall of unbaked bricks. Covering one wall of this came the second temple of about 40ft. square in a wall about 10ft. thick. An outer *temenos* (enclosure) wall surrounded the ground. This outer wall was thickened about the 2nd or 3rd dynasty. The old temple entirely vanished in the 4th dynasty, and a smaller building was erected behind it, enclosing a wide hearth of black ashes. Pottery models of offerings are found in the ashes, and these were probably the substitutes for sacrifices decreed by Cheops (Khufu) in his temple reforms. A great clearance of temple offerings was made now, or earlier, and a chamber full of them has yielded the fine ivory carvings and the glazed figures and tiles which show the splendid work of the 1st dynasty. A vase of Menes with purple inlaid hieroglyphs in green glaze and the tiles with relief figures are the most important pieces. The noble statuette of Cheops in ivory, found in the stone chamber of the temple, gives the only portrait of this ruler. The temple was rebuilt entirely on a larger scale by Pepi I. in the 6th dynasty. He placed a great stone gateway to the temenos, an outer temenos wall and gateway, with a colonnade between the gates. His temple was about 40 x 50ft inside, with stone gateways front and back, showing that it was of the processional type. In the 11th dynasty Menthotp (Mentuhotep) III. added a colonnade and altars. Soon after, Sankhkerē entirely rebuilt the temple, laying a stone pavement over the area, about 45ft. square, besides subsidiary chambers. Soon after Senwosri (Senusert) I. in the 12th dynasty laid massive foundations of stone over the pavement of his predecessor. A great temenos was laid out enclosing a much larger area, and the temple itself was about three times the earlier size.

The 18th dynasty began with a large chapel of Amasis I , and then Thothmes III built a far larger temple, about 130 x 200ft. He made also a processional way past the side of the temple to the cemetery beyond, with a great gateway of granite Rameses III added a large building, and Amasis II in the 26th dynasty rebuilt the temple again, and placed in it a large monolith shrine of red granite, finely wrought The foundations of the successive temples were comprised within about 18ft depth of ruins

The temple of Seti I was built on entirely new ground half a mile to the south of the long series of temples just described This is the building best known as the Great Temple of Abydos, being nearly complete and an impressive sight. The long list of the kings of the principal dynasties carved on a wall is known as the "Table of Abydos " There were also seven chapels for the worship of the king and principal gods. The temple was originally 550ft long, but the forecourts are scarcely recognizable, and the part in good state is about 250ft long and 350ft wide, including the wing at the side Excepting the list of kings and a panegyric on Rameses II , the subjects are not historical but mythological The adjacent temple of Rameses II. was much smaller and simpler in plan; but it had a fine historical series of scenes around the outside, of which the lower parts remain A list of kings, similar to that of Seti, formerly stood here; but the fragments were sold by the French consul to the British Museum

The royal tombs of the earliest dynasties were placed about a mile back on the great desert plain The earliest is about 10 x 20ft inside, a pit lined with brick walls, and originally roofed with timber and matting Others also before Menes are 15 x 25ft The tomb probably of Menes is of the latter size After this the tombs increase in size and complexity. The tomb-pit is surrounded by chambers to hold the offerings, the actual sepulchre being a great wooden chamber in the midst of the brick-lined pit. Rows of small tomb-pits for the servants of the king surround the royal chamber, many dozens of such burials being usual By the end of the 2nd dynasty the type changed to a long passage bordered with chambers on either hand, the royal burial being in the middle of the length. The greatest of these tombs with its dependencies covered a space of over 3,000sq. yards. The contents of the tombs have been nearly destroyed by successive plunderers, enough remained to show that rich jewellery was placed on the mummies, a profusion of vases of hard and valuable stones from the royal table service stood about the body, the store-rooms were filled with great jars of wine, perfumed ointment and other supplies, and tablets of ivory and ebony were engraved with a record of the yearly annals of the reigns.

The cemetery of private persons begins in the 1st dynasty with some pit tombs in the town. It was extensive in the 12th and 13th dynasties and contained many rich tombs. In the 18th–20th dynasties a large number of fine tombs were made, and later ages continued to bury here till Roman times.

The forts lay behind the town That known as Shunet ez Zebib is about 450 x 250ft over all, and still stands 30ft. high. It was built by Khasekhemui, the last king of the 2nd dynasty. Another fort nearly as large adjoined it, and is probably rather older. A third fort of a squarer form is now [illegible] the Coptic convent; its age cannot be ascertained.

Jean Capart, *Abydos: Le Temple de Seti I.* (Bruxelles, 1912) ; *The Cemeteries of Abydos,* 3 vols. (Egypt Exploration Fund, 1913–14).

**ABYSS,** any deep place (Gr. *ἀ-*, privative, *βυσσός*, bottom), a bottomless depth. From the late popular *abyssimus* (superlative of Low Latin *abyssus*) through the French *abisme* (i.e., *abîme*) is derived the poetic form *abysm,* pronounced as late as 1616 to rhyme with *time.* The adjective "abyssal" or "abysmal" has been used by zoologists to describe deep regions of the sea. In heraldry the abyss is the middle of an escutcheon. In the Greek version of the Old Testament the word represents (1) the original chaos (Gen. i. 2), (2) the Hebrew *tehom,* which is used also in apocalyptic literature and in the New Testament for hell. In the Septuagint cosmography the word is applied (*a*) to the waters under the earth, and (*b*) to the waters of the firmament

which were regarded as closely connected with those below. Derivatively it acquired the meaning of the place of the dead. In *Revelation* it is the prison of evil spirits whence they may occasionally be let loose, and where Satan is doomed to spend 1,000 years. In rabbinical cosmography the abyss is a region of Gehenna situated below the ocean bed and divided into three or seven parts imposed one above the other. In the Kabbalah the abyss as the opening into the lower world is the abode of evil spirits, and corresponds to the opening of the abyss to the world above. In general, the abyss is regarded vaguely as a place of indefinite extent, the abode of mystery and sorrow.

**ABYSSINIA** (officially Ethiopia), an inland country and empire of North-east Africa lying, chiefly, between 5° and 15° N. and 35° and 42° E. It is bounded on the north by Eritrea (Italian), on the west by the Anglo-Egyptian Sudan, on the south-west and south by Uganda and Kenya, on the south-east and east by British, Italian and French Somaliland. The coast lands in European hands, which cut off Abyssinia from access to the sea, vary in width from 40 to 250 miles and are narrowest on the north-east border near the Red Sea. Abyssinia in the north is 230m. east to west, but is 900m. wide along latitude 9° N., and resembles a triangle with apex north. It is divided into Abyssinia proper (*i.e.*, the old Ethiopian empire consisting of Tigré, Amhara, Gojam and part of Shoa) with the south-west Galla highlands and the remainder of Shoa all forming a geographical unit—and cut off from it by the great Rift valley—and the Somaliland plateau with Harar: nearly all this country being surrounded by tracts of low-lying desert. The area of the whole State is 305,731 sq.mi., of which Abyssinian Somaliland covers about a third. Pop. (1939) estimated at about 9,450,000.

## PHYSICAL FEATURES

Between the Upper Nile and the low south-west shores of the Red Sea and the Gulf of Aden lie elevated plateaux with mountain ranges. The plateaux rise abruptly from the plains, constituting outer mountain chains. The Abyssinian highlands are thus a clearly marked orographic division From Ras Kasar (18°N.) to Annesley Bay (15°N.) the eastern wall of the plateau runs parallel to the Red Sea. It then turns due south and follows closely the line of 40°E. for some 400m. About 9°N. the River Hawash flows east through the opening of the Rift valley. The main range at this point trends south-west, while south of the Hawash valley, which is some 3,000ft. below the level of the mountains, another massif rises in a direct line south. The second range sends a chain (the Harar Hills) east to the Gulf of Aden. The two chief eastern ranges run parallel south by west on either side of the Rift valley—in which are a series of lakes—to about 3°N., the outer (eastern) spurs of the plateau still keeping along the line of 40°E. The southern escarpment of the plateau is highly irregular, but has a general direction north-west and south-east from 6°N. to 3°N. The western wall of the plateau, from 6°N. to 11°N., is precipitous. North of 11°N. the hills turn more to the east, and fall more gradually to the plains at their base. On its northern face also the plateau falls in terraces to the level of the eastern Sudan. The eastern escarpment has a mean height of 7,000 to 8,000ft., and is often precipitous. Torrents descend narrow deep clefts to lose themselves in the sandy coast land; they afford means of reaching the plateau, as alternatives to the easier route through the Hawash valley. On surmounting this rocky barrier the traveller finds that the encircling rampart rises little above the normal level of the plateau. The northern highlands, mainly 10° to 15°N., consist of Archaean rocks of mean height 7,000 to 7,500ft., and a deep central depression contains Lake Tana. Above the plateau mountain ranges rise to 12,000 and over 15,000ft., with fantastic forms, and cut by enormous fissures due to erosion; some are wider, others have the opposite walls but 200 or 300yd. apart, and fall almost vertically thousands of feet. Numerous isolated flat-topped hills or small plateaus known as *ambas*, are left. The highest peaks are in the Simen (or Semien) ranges, north-east of Lake Tana, which culminate in a snow-covered peak, Dajan (15,160ft.). Parallel with the eastern escarpment the heights rise to Mt. Kollo (14,100ft.) south-west of Magdala. The valley between these hills and the eastern escarpment is one of the largest and most profound chasms in Abyssinia. Between Lake Tana and the eastern hills are Mounts Guna (13,800ft.) and Uara Sahia (13,000ft.) The highlands south of latitude 10°N. have more open tableland than the northern portion and fewer lofty peaks, but the general character is still that of a much broken hilly plateau

The uplands usually slope north-west and nearly all the large rivers flow to the Nile; the Takkaze in the north, the Abbai in the centre, and the Sobat in the south make up four-fifths of the entire drainage. The rest is carried off almost due north by the Khor Baraka, which occasionally reaches the Red Sea south of Suakin, by the Hawash, which runs out in the salt lake area near the head of Tajura Bay; by the Webi Shibeli and Juba, which flow south-east through Somaliland, though the Shibeli fails to reach the Indian ocean; and by the Omo, the main feeder of the closed basin of Lake Rudolf The Takkaze, the true upper course of the Atbara, falls from about 7,000ft. in the central tableland to 2,500ft in the tremendous crevasse through which it sweeps west, north, and west again, to the western terraces and the Sudan. During the rains the Takkaze (*i.e.*, the "Terrible") rises some 18ft. above its normal level, and at this time forms an impassable barrier between the northern and central provinces Lower down, the river has the Arab name Setit The Setit is joined (14° 10′N., 36°E.) by the Atbara, formed by several streams of the mountains west and north-west of Lake Tana. The Gash or Mareb is the most northerly Abyssinian river flowing towards the Nile. It rises on the landward side of the eastern escarpment within 50 miles of Annesley Bay on the Red Sea, and reaches the Sudan near Kassala to lose itself in the sandy plain. The Mareb is dry for a great part of the year, but like the Takkaze has sudden freshets during rains. Only the left bank of the upper course of the river is in Abyssinian territory, the Mareb here forming the boundary between Eritrea and Abyssinia

The Abbai or Blue Nile has its source near Mt. Denguiza in the Gojam highlands (about 11°N. and 37°E.) and first flows for 70m. nearly due north to the south side of Lake Tana (*q.v.*), through which it runs for some 20 miles and, escaping by a deep crevasse, bends in a great semicircle, east, south and north-west, the reverse of that of the Takkaze, down to the plains of Sennar. The Abbai has many perennial tributaries, of which the principal are the Bashilo, the Jamma, the Muger, the Gudiv, the Didessa, largest of all, and the Yabus. The right-hand tributaries, rising mostly on the western sides of the plateau, have steep slopes and are generally torrential; the Bolassa is perennial, and the Rahad and the Dinder are important in flood-time.

In the mountains and plateaux of Kaffa and Galla in south-west Abyssinia rise the chief affluents of the Sobat tributary of the Nile. The Akobo joins the Pibor, which unites with the Baro to form the Sobat. These rivers (which form for 250m the west or south-west frontiers of Abyssinia) descend in great falls, and like other Abyssinian streams are unnavigable in their upper courses. The Baro on reaching the plain affords, however, an open waterway to the Nile (*see* NILE; SOBAT and SUDAN).

The chief eastward river is the Hawash, rising in the Shoan uplands and bending first south-east and then north-east. It reaches the Afar (Danakil) lowlands through a broad breach in the eastern escarpment of the plateau, where it is nearly 200ft wide and 4ft. deep, even in the dry season, and during the floods rises 50 or 60ft. above low-water mark, thus inundating the plains for many miles along both its banks. Yet it fails to reach the coast and after a winding course of about 500m. is lost near Lake Aussa, some 60 or 70m. from the head of Tajura Bay. From Shoa south-west to Lake Rudolf extends a chain of lovely upland lakes, some fresh, some brackish, some completely closed, others connected by short channels, the chief links in their order from north to south being:— Zwai, communicating southwards with Hora Abyata, which connects with Langana, all in the Arusi Galla territory; then Shala and Awusa; farther south Abaya (Margherita) with an outlet to a smaller tarn, Chamo, in the romantic Baroda and Gamo districts, skirted on the west by grassy slopes and wooded ranges (6,000 to nearly 9,000ft.);




DRAWN BY JOHN BARTHOLOMEW & SONS LTD., EDINBURGH

ABYSSINIA COVERS 305,731 SQ.MI., OF WHICH ABYSSINIAN SOMALILAND MAKES NEARLY A THIRD. MOST OF THE COUNTRY WEST OF 40° IS A PLATEAU FROM WHICH RISE VARIOUS MOUNTAIN RANGES. ON EVERY SIDE EXCEPT THE SOUTH THE WALLS OF THE PLATEAU RISE ABRUPTLY FROM THE PLAINS. IN A DAY'S JOURNEY THE TRAVELLER MAY PASS FROM TROPICAL TO ALMOST ALPINE CONDITIONS OF CLIMATE. EQUALLY GREAT IS THE RANGE OF THE FLORA AND FAUNA. THERE ARE FEW LARGE TOWNS

lastly, in the Asille country, Lake Stefanie, the Chuwaha of the natives, completely closed and about 1,800ft. above sea. To the same system obviously belongs the neighbouring Lake Rudolf (*q.v.*), larger than all the rest together. This lake receives at its northern end (1,800ft. above sea level) the waters of the Omo, a rapid and unnavigable perennial stream with many affluents, rising in the Shoa highlands and falling 6,000ft. in its course of 370m. The chief rivers of Somaliland (*q.v.*), Webi Shibeli and Juba (*q.v.*), rise on the south-eastern slopes of the Abyssinian escarpment and most of their course is through Abyssinian territory.

## GEOLOGY

The East African tableland is continued into Abyssinia, the following formations being represented:—

**Archaean.**—Metamorphic rocks, the main mass of the tableland, are exposed in every deep valley in Tigré and along the Blue Nile. Mica schists are most prevalent. Hornblende schists also occur and a compact felspathic rock in the Suris defile. The foliae of the schists strike north and south.

**Triassic (?).**—In the region of Adigrat the metamorphic rocks are invariably overlain by white and brown sandstones, unfossiliferous, and attaining a maximum thickness of 1,000ft. They are overlain by the fossiliferous limestones of the Antalo group. Around Chilga and Adigrat coal-bearing beds occur, which Blanford suggests may be of the same age as the coal-bearing strata of India. The Adigrat sandstone possibly represents some portion of the Karroo formation of South Africa.

**Jurassic.**—The fossiliferous limestones of Antalo are generally horizontal, but much disturbed when interstratified with trap rocks. The fossils are all characteristic Oolite forms and include a species of *Hemicidaris, Pholadomya, Ceromya, Trigonia* and *Alaria.*

**Igneous Rocks.**—Above a height of 8,000ft. the country consists of bedded traps belonging to two distinct and unconformable groups. The lower (Ashangi group) consists of basalts and dolerites often amygdaloidal. Their relation to the Antalo limestones is uncertain, but Blanford considers them to be not later in age than the Oolite. The upper (Magdala group) contains

much thick trachytic rock lying perfectly horizontally, and giving rise to a series of terraced ridges characteristic of central Abyssinia. They are interbedded with unfossiliferous sandstones and shales. Of more recent date (probably Tertiary) are some igneous rocks, rich in alkalis, in parts of southern Abyssinia. Still more recent are the basalts and ashes west of Massawa and around Annesley Bay, and known as the Aden volcanic series. The older igneous rocks have suffered severe denudation, giving deep and narrow ravines, sometimes to a depth of 3,000 to 4,000ft.

**Climate.**—Somaliland and the Danakil lowlands are hot and dry with semi-desert conditions; the lower basin of the Sobat is hot, swampy and malarious. But over most of Abyssinia, as well as the Galla highlands, the climate is very healthy and temperate. The country lies wholly within the tropics, but its nearness to the equator is counterbalanced by the elevation of the land. In the deep valley of the Takazze and Abbai, and generally below 4,000ft., conditions are torrid and fevers prevalent. On the uplands, however, the air is bracing and the nights very bleak. The mean range of temperature is between 60° and 80°. On the higher mountains the climate is Alpine. The atmosphere on the plateaus is exceedingly clear. In addition to variation in climate with elevation, the year may be divided into two main seasons, the dry (*baga*) from Oct. to mid-June, and the rainy (*karamt*), caused by the south-west monsoon, from mid-June to the end of September. There is also a period of so-called "little rains," generally about March.

The incidence of the rains varies slightly in different parts of the country, the rain moving from north to south; the average annual rainfall at Addis Ababa over a period of 25 years amounted to 1,200mm.; it is on the whole rather lighter in the north. The rainy season is of great importance not only to Abyssinia but to the countries of the Nile valley, as the prosperity of the eastern Sudan and Egypt is largely dependent upon the Abyssinian rainfall.

**Flora and Fauna.**—As in a day's journey the traveller may pass from torrid to almost Alpine conditions of climate, so great also is the range of flora and fauna. In the valleys and lowlands vegetation is dense, but the plateaus are comparatively bare, with thinly scattered trees and bushes. The glens and ravines are often thickly wooded, and offer a delightful contrast to the open downs. These conditions are particularly characteristic in the north; in the south the upland vegetation is more luxuriant. The date palm, mimosa, wild olive, giant sycamores, junipers and laurels, the myrrh and other gum trees (gnarled and stunted, these flourish most on the eastern foothills), a magnificent pine (the Natal yellow pine, which resists the attacks of the white ant), the fig, orange, lime, pomegranate, peach, apricot, banana and other fruit trees; the grape vine (rare), blackberry and raspberry; the cotton and indigo plants, and occasionally the sugar cane, are all found. There are in the south large forests of valuable timber; and the coffee plant is indigenous in the Kaffa country, whence it takes its name. Many grasses and flowers abound. Large areas in the highlands are covered by the Kosso tree, which grows from 30 to 40ft. high and has abundant pendant red blossoms; the flowers and the leaves are prized for medicinal purposes. The fruit of the kurarina, found almost exclusively in Shoa, yields a black grain highly esteemed as a spice. On the tableland a great variety of grains and vegetables are cultivated. A fibrous plant, the sansevieria, grows wild in the semi-desert regions of the north and south-east.

Elephant and rhinoceros are found in low-lying districts, especially in the Sobat valley. The hippopotamus and crocodile inhabit many of the rivers and lakes, in some of which otters of large size are plentiful. Lions abound in the low countries and in Somaliland. Leopards, spotted and black, are numerous and often large; hyaenas are found everywhere and are hardy and fierce; lynx, wolf, wild dog and jackal are also common. Boars and badgers are more rarely seen. The giraffe is found in the west; the zebra and wild ass frequent the lower plateaux and the rocky hills of the north. Antelopes and gazelles of many varieties are numerous in most parts and include greater and lesser kudu (both rather rare), oryx, duiker, gemsbuck, hartebeest, gerenuk (the most common—it has long thin legs and a camel-like neck), klip-springer, found on the high plateaus as well as in the lower districts, and the dik-dik, the smallest of the antelopes, rarely over 10 lb., common in the low countries and the foothills. The rarest of all these is the nyala. The civet is found in many parts but chiefly in the Galla regions. Squirrels and hares, monkeys, notably the guereza, gelada, guenon and dog-faced baboon, range abundantly from the warm lowlands to heights of 10,000ft. Eagles, vultures, hawks, bustards and other birds of prey, partridges, duck, teal, guinea-fowl, sand-grouse, curlews, woodcock, snipe, pigeons, thrushes and swallows are very plentiful. A fine variety of ostrich is common. Among birds prized for plumage are the marabout, crane, heron, blackbird, parrot, jay, and many sun-birds of extraordinary brilliance. Serpents are not numerous but several are poisonous. The bee's honey is an important part of the people's food. The locust is a pest. There are thousands of varieties of butterflies and other insects.

## ADMINISTRATION AND INDUSTRY

**Provinces and Towns.**—The ancient provincial divisions of Abyssinia (Amhara, Tigré, Gojam, Shoa, etc.) are for the most part now mere geographical expressions, having been broken up into smaller governorships with the exception of the ancient kingdom of Gojjam, enclosed by the great bend of the Abbai, which is still a single governorship. The more important provinces number about 20, of which may be mentioned: Gojam, North and South Tigré, Bagemdir, Harar, Salale, Waag and Lasta and Jimma. Each is divided into sub-districts and further subdivided into groups of villages. With the exception of the capital, Addis Ababa (*q.v.*), Harar, and Diredawa, there are no towns of any size in Abyssinia. Centuries of almost continual warfare between the provinces help to account for the absence of large towns; also royal residences have changed frequently on exhaustion of fuel supplies. The earliest capital appears to have been Aksum (*q.v.*), in Tigré, where there are extensive ruins. Gondar in Amhara was the capital from the middle ages to the middle of the 19th century. Addis Ababa in Shoa, the capital since 1892, has about 150,000 inhabitants, Diredawa 30,000 and Harar 25,000

None of the other towns has a permanent population exceeding 6,000 to 10,000, but several have large periodic markets. In Tigré are Aduwa (17m. E. by N. of Aksum), Aksum, Adigrat, Makale and Antalo. The three last are near the eastern escarpment of the high plateau on the direct road South from Massawa to Shoa. West of Adigrat is the monastery of Debra-Damo, a most celebrated sanctuary.

In Amhara are Magdala (*q.v.*), formerly the residence of King Theodore, and the place of imprisonment of the British captives in 1866; Debra-Tabor ("Mount Tabor"), the chief royal residence under King John in a strong strategic position, overlooks the fertile plain east of Lake Tana about 8,620ft. above sea. Amba-Mariam, a fortified station midway between Gondar and Debra-Tabor near the north-east side of Lake Tana, with a population of 3,000, has the famous shrine and church dedicated to St. Mary, whence the name Mahdera-Mariam ("Mary's Rest"). It was a royal residence, and is an important market and place of pilgrimage, a few miles south-west of Debra-Tabor; Sokota, a great central market, capital of Waag, is at the convergence of several main routes. In Shoa are: Ankober, formerly the capital of the kingdom, Debra-Birhan ("Mountain of Light"), once a royal residence; Liché (Litché), one of the largest market towns in the south. Lfeka, the largest market in Gallaland, communicates direct with Gojam, Shoa and other parts of the empire. Anderacha, the commercial centre of Kaffa, and Jiren, capital of the neighbouring province of Jimma, attract traders from surrounding provinces.

**Communications.**—There is a single line of railway from Jibuti to Addis Ababa (486m.) but, outside the capital, there are no roads for wheeled traffic. Transport is by mules, donkeys, pack-horses and (in the lower regions) camels. Telegraph lines connect Addis Ababa and several important towns of the North with Massawa, Harar and Jibuti. There is also a telephonic

service, but outside Addis Ababa, the capital, it is subject to frequent interruption.

**Agriculture.**—The soil is exceedingly fertile and agriculture is extensively followed; in the lower regions maize, durra, wheat, barley, rye, *teff*, pease, cotton and sugar-cane are grown. *Teff*, a kind of millet with pinhead grains, is the common bread grain. The low grounds also produce a grain, *tocussa*, from which black bread is made. Certain oleaginous plants, the *suf*, *nuc* and *selite* (no European equivalents for the native names), and the groundnut, are largely grown. The castor bean grows wild, the green castor in the low, damp regions, the red castor at medium altitudes. The kat plant, a medicinal tonic, is largely grown in Harar province. On the higher plateaus the chief crops are wheat, barley, teff, peppers, vegetables of all kinds and coffee. Above 10,000ft. one finds barley, oats, beans and occasionally wheat. Of all cereals teff and barley are the most widely and generally grown. In the high plateaus sowing begins in May, in the lower plateaus and the plains in June, but where the summer is long and rain abundant sowing and reaping are going on at the same time. Most regions yield two, many three, crops a year.

**Stock.**—The land is admirably adapted for stock raising; enormous herds of cattle estimated at from 10 to 15 million head are found in Abyssinia, of which the most remarkable are the immensely long horned Sanga or Galla oxen. Most cattle are of the zebu or hump-backed variety, but there are also two breeds—one large, the other resembling the Jersey cattle—which are straight-backed. Sheep, of which there are also immense flocks, belong to the short and fat-tailed variety. The majority are not wool-bearing, but in one district a very small black sheep is raised for wool. The small mountain breed of sheep weigh no more than 20 to 30lb. apiece. Goats are of both the long and short-haired varieties, those from the Arusi Galla country having fine silky hair sometimes 16in. long. Large quantities of butter, generally rancid, are made from the milk of cows, goats and sheep. In the Leka province small black pigs are bred in considerable numbers. The horses (very numerous) are strong and only about 14 hands high. The best breeds come from the Shoa uplands. The ass is also small and strong; and the mule, bred in large numbers, is of excellent quality, and, both as a transport animal and as a mount, is preferred to the horse. The mule, which averages 12 hands, thrives in every condition of climate, is fever-proof, travels over the most difficult mountain passes with absolute security and carries a load of from 150 to 200lb.

**Minerals.**—In the south and west provinces placer gold mines along the water-courses are worked by Gallas as an industry subsidiary to tending their flocks and fields. In the Wallega district veins of gold-bearing quartz and finds of platinum have been reported. Iron, coal, potash and other minerals are found. Rock-salt is obtained from the province of Tigré.

**Trade and Currency.**—The small progress in the economic and commercial development may be attributed to disturbed political conditions (until quite recently), the lack of communications, bad methods of taxation, suspicion of foreign enterprise and currency difficulties. Some European commercial enterprises have been started and there are indications that the Government will be able to give more sympathetic attention in the future to this. A Belgian company has acquired the alcohol monopoly, but is meeting with great difficulties; a Franco-Belgian company has been formed for cotton cultivation, two Belgian companies are developing large coffee plantations in addition to a few smaller undertakings. Banking is a monopoly of the Bank of Abyssinia (a branch of the National Bank of Egypt) under charter of Emperor Menelek.

The total trade approximates £2,500,000 annually. The chief exports are coffee and hides, and the principal imports, salt, cotton fabrics and hardware. The main channel of trade is the Franco-Ethiopian railway, from Addis Ababa to the port of Jibuti in French Somaliland. The principal trade routes with the Sudan are via Gambela, Gallabat and Roseires. Other trade routes are through the Italian colony of Eritrea to Massawa, and through Harar to Berbera in British Somaliland. The currency is the Maria Theresa and Menelek dollars of a nominal value of about 2s., but in parts of the country bars of salt or even cartridges are used.

**Government.**—The political institutions are of a feudal character, and within their provinces the *rases* and other chiefs exercise large powers. The empress and regent have a number of ministers and a council of elders of the Crown. The legal system (*Feta Negast*) is a strange combination of various origins based on the Mosaic Code; the chief judicial officer is the *Aja Negus* (breath of the king). From all decisions there is an appeal to the throne. The powerful Abyssinian Church (*q.v.*) is presided over by the *Abuna*, always a Copt nominated from Egypt. The priests, an ignorant body, teach the scriptures in Giz, a tongue understood by very few. Apart from this and two schools in Addis Ababa, for which a few European teachers have been introduced, education is practically non-existent. The Abyssinian calendar divides the year into 12 months of 30 days each, followed by one month of five days (six in leap year). The year begins on 1st Maskaram, our Sept. 11 (12 in the European year preceding our leap year) and is then seven years behind the European year; from Jan. 1 to Sept. 10 it is eight years behind. The land is not held in fee simple but is subject to the control of the throne or the church. Revenue is derived from a 10% customs duty on imports, and from a levy on all forms of productions; but as the provincial governors receive no salaries the receipts of the central Government are subject consequently to fluctuations. (C. F. R.)



BY COURTESY OF BARNUM BROWN

ABYSSINIAN NATIONAL COSTUME: A CHIEF IN GALA DRESS WITH LION'S MANE COLLAR AND HEADDRESS AND AN INDIVIDUAL IN EVERY-DAY DRESS WITH WOOLLEN BURNOUS

**Defence.**—The early history of Abyssinia was marked by the struggles of an early Christian community against pagan and Mohammedan invaders. Early Portuguese records (1520–27) contain some entries of military interest. King Theodore (b. 1818) first conceived the idea of organizing an Abyssinian army on European lines. His power was broken in 1868 by an expedition under Lord Napier of Magdala, sent to the succour of Europeans whom he had made prisoner. (*See* also EGYPT: *Egypt and Sudan Campaigns, 1882–1900*).

In March 1896 Theodore's successor Menelek successfully defended the country against an Italian invading force, 200,000 men responding to his call to arms.

In time of war every able-bodied Abyssinian is expected to serve.

According to estimates, about 250,000–300,000 Abyssinians (including a small standing army) could be equipped with modern rifles; but lack of commissariat would prevent a large force from keeping the field long.

From 1890 onwards various expedients had been adopted ineffectively by the European Powers to limit the import of arms.

Under the terms of a treaty concluded in May 1902 an area near Itang (Baro river) bordering the Sudan cannot be used for any military purpose (State Papers, vol. 95, p. 467). (G. G. A.)

## HISTORY

**Early Records.**—Abyssinia, or at least the northern portion of it, was included in the tract of country known to the ancients as Ethiopia, the northern limits of which reached at one time to about Syene. The connection between Egypt and Ethiopia was in early times very intimate, and occasionally the two countries were under the same ruler, so that the arts and civilization of the one naturally found their way into the other. In early times, too, the Hebrews had commercial intercourse with the Ethiopians; and according to Abyssinian tradition the queen of

Sheba who visited Solomon was a monarch of their country, and from their son Menelek the kings of Abyssinia claim descent. During the Captivity many of the Jews settled here and brought with them a knowledge of the Jewish religion. Under the Ptolemies, the arts as well as the enterprise of the Greeks entered Ethiopia, and led to the establishment of Greek colonies. Out of these Greek colonies appears to have arisen the kingdom of Auxume which flourished from the 1st to the 7th century A.D. and was at one time nearly coextensive with Abyssinia proper. The capital Auxume and the seaport Adulis were then the chief centres of the trade with the interior of Africa in gold dust, ivory, leather, aromatics, etc. At Axum, the site of the ancient capital, many vestiges of its former greatness still exist; and the ruins of Adulis, which was once a seaport on the bay of Annesley, are now about 4 miles from the shore (*see* the article, ETHIOPIA).

**Introduction of Christianity.**—Christianity was introduced into the country by Frumentius (*q.v.*), who was consecrated first bishop of Ethiopia by St. Athanasius of Alexandria about A.D. 330. From the scanty evidence available it would appear that the new religion at first made little progress, and the Axumite kings seem to have been among the latest converts. Towards the close of the 5th century a great company of monks established themselves in the country, and since that time monachism has been a power among the people and not without its influence on the course of events. In the early part of the 6th century the king of the Homerites, on the opposite coast of the Red Sea, having persecuted the Christians, the emperor Justinian I. requested the king of Auxume, Caleb or El-Ẽsbaha, to avenge their cause. He accordingly collected an army, crossed over into Arabia, and conquered Yemen (*c.* 525), which remained subject to Ethiopia for over 50 years. This was the most flourishing period in the annals of the country. The Ethiopians possessed the richest part of Arabia, carried on a large trade, which extended as far as India and Ceylon, and were in constant communication with the Greek empire. Their expulsion from Arabia, followed by the conquest of Egypt by the Mohammedans in the middle of the 7th century, changed this state of affairs, and the continued advances of the followers of the Prophet at length cut them off from almost every means of communication with the civilized world; so that, as Gibbon says, "encompassed by the enemies of their religion, the Ethiopians slept for near a thousand years, forgetful of the world by whom they were forgotten." About A.D. 960, a Jewish princess, Judith, conceived the design of murdering all the members of the royal family, and of establishing herself in their stead. During the execution of this project, the infant king was carried off by some faithful adherents, and conveyed to Shoa, where his authority was acknowledged and the Solomonean dynasty ruled for about 300 years; while Judith reigned for 40 years over the rest of the kingdom after which a usurping dynasty of Lasta held the reins of power (except in Shoa) until in 1268 the kingdom was restored to the royal house in the person of Yekūnō Amlāk.



BY COURTESY OF B. BROWN

ABYSSINIAN LADY WEARING WHITE SHAMMA (THE NATIONAL TOGA) WITH COLOURED STRIPES

**Advent of the Portuguese.**—Towards the close of the 15th century the Portuguese missions into Abyssinia began. A belief had long prevailed in Europe of the existence of a Christian kingdom in the far east, whose monarch was known as Prester John, and various expeditions had been sent in quest of it. Among others who had engaged in this search was Pedro de Covilham, who arrived in Abyssinia in 1490, and, believing that he had at length reached the far-famed kingdom, presented to the negūs, or emperor of the country, a letter from his master the king of Portugal, addressed to Prester John. Covilham remained in the country, but in 1507 an Armenian named Matthew was sent by the negūs to the king of Portugal to request his aid against the Mohammedans. In 1520 a Portuguese fleet, with Matthew on board, entered the Red Sea in compliance with this request, and an embassy from the fleet visited the negūs, Lebna Dengel or Dawit (David) II., and remained in Abyssinia for about six years. One of this embassy was Father Francisco Alvarez, from whom we have the earliest and not the least interesting account of the country. Between 1528 and 1540 armies of Mohammedans, under the renowned general Mohammed Grañ (probably a Somali), entered Abyssinia from the low country to the south-east, and overran the kingdom, obliging the emperor to take refuge in the mountain fastnesses. In this extremity recourse was again had to the Portuguese, who sent a fleet, under the command of Stephen da Gama, from India, which arrived at Massawa in Feb. 1541. In the July following a force of 450 musqueteers, under the command of Christopher da Gama, younger brother of the admiral, left the fleet and marched into the interior, and being joined by native troops were at first successful against the enemy; but they were subsequently defeated, and their commander taken prisoner and put to death (Aug 1542). On Feb. 21, 1543, however, Mohammed Grañ was shot in an engagement and his forces totally routed. After this, quarrels arose between the negūs and the Portuguese, who now wished the emperor publicly to profess himself a convert to Rome, which the negūs refused to do. The Jesuits who had accompanied or followed the da Gama expedition into Abyssinia, and fixed their headquarters at Fremona (near Adowa), were oppressed and neglected, but not actually expelled. In the beginning of the 17th century Father Pedro Paez arrived at Fremona, a man of great tact and judgment, who soon rose into high favour at court, and gained over the emperor to his faith. He directed the erection of churches, palaces and bridges in different parts of the country, and carried out many useful works. His successor Mendez was a man of much less conciliatory manners, and the feelings of the people became strongly excited against the intruders, till at length, on the death of the negūs, Socinius or Seged I., and the accession of his son Fasilidas in 1633, they were all sent out of the country, after having had a footing there for nearly a century and a half.

**Penetration of European Travellers.**—The French physician C. J. Poncet, who went there in 1698, via Sennar and the Blue Nile, was the only European that afterwards visited the country before Bruce in 1769. James Bruce's main object was to discover the sources of the Nile, which he was convinced lay in Abyssinia. Accordingly, leaving Massawa in Sept. 1769, he travelled via Axum (Aksum) to Gondar, and was well received by King Tekla Haimanot II. He accompanied the king on a warlike expedition round Lake Tana, crossing the genuine Blue Nile (Abbai) close to its point of issue from the lake. On a second expedition of his own he proved to his own satisfaction that the river originated some 40m. S.W. of the lake at a place called Geesh (Nov. 4, 1770). He showed that this river flowed into the lake, and left it by its now well-known outlet. In 1805 the first British mission under Lord Valentia and Mr. Henry Salt was sent to conclude an alliance with Abyssinia and obtain a port on the Red Sea in case France secured Egypt by dividing up the Turkish Empire with Russia. This mission was succeeded by many travellers, missionaries and merchants of all countries. Prominent amongst them were Dr. C. T. Beke (*q.v.*) who did much to extend geographical knowledge of the country from 1840 to 1843, and Mr. Mansfield Parkyns (1843–46) who wrote the most interesting book on the country since Bruce.

In 1830 Protestant missionary enterprise was begun by Samuel Gobat and Christian Kugler, who were sent out by the Church Missionary Society and were well received by the Ras of Tigré, but in 1838 most of the missionaries were obliged to leave the country owing to the opposition of the native priests. Later on, however (1856), Bishop Gobat conceived the idea of sending lay missionaries who would engage in secular occupations as well as missionary work. Their secular work appears to have been the more appreciated, and King Theodore employed them as workmen and established them at Gaffat, near his capital.

**Position of the Negusa Nagast.**—In order to obtain a clear view of native Abyssinian history, as distinct from the visits and

influence of Europeans. it must be borne in mind that during the last 300 years, and indeed for a longer period, for the old chroniclers may be trusted to have given a somewhat distorted view of the importance of the particular chieftains with whom they came in contact, the country has been merely a conglomeration of provinces and districts, ill defined, loosely connected and generally at war with each other. Of these the chief provinces have been Tigré (northern), Amhara (central), Gojam (north western) and Shoa (southern). The seat of government, or rather of overlordship, has usually been in Amhara, the ruler of which, calling himself negusa nagast (king of kings, or emperor), has exacted tribute, when he could, from the other provinces. The title of negusa nagast has been to a considerable extent based on the blood in the veins of the claimant. All the emperors have based their claims on their direct descent from Solomon and the queen of Sheba; but it is needless to say that in many, if not in most, cases their success has been due more to the force of their arms than to the purity of their lineage. Some of the rulers of the larger provinces have at times been given or have given themselves, the title of negūs or king, so that on occasion as many as three, or even more, negūses have been reigning at the same time; and this must be borne in mind by the student of Abyssinian history in order to avoid confusion of rulers. The whole history of the country is, in fact, with a few bright intervals due to the efforts of some of the more enlightened monarchs, one gloomy record of internecine wars, barbaric deeds and unstable governments, of adventurers usurping thrones, only to be themselves unseated, and of raids, rapine and pillage.

Thus, for example, though the Empire had been re-united under Yekūnō Amlāk of the Solomonean dynasty in 1268, the overlordship of the Negūs or Negusa Nagast (king of kings) had become purely nominal by the 18th century, and the rulers of Tigré and Amhara alternately held the real power. Between these two quasi-kingdoms there was perpetual hostility and much fighting, but without definite results until Kassa (later King Theodore of Magdala fame) appeared on the scene.

## KING THEODORE

**Origin and Rise.**—Lij Kassa was born in Kwara, a small district of Western Amhara, in 1818. His father was a small local chief, and his uncle was governor of the districts of Dembea, Kwara and Chelga between Lake Tana and the undefined N.W. frontier. He was educated in a monastery, but preferred a more active life, and by his talents and energy came rapidly to the front. On the death of his uncle he was made chief of Kwara, but in consequence of the arrest of his brother Bilawa by Ras Ali, he raised the standard of revolt against the latter, and, collecting a large force, repeatedly beat the troops that were sent against him by the ras (1841–47). On one occasion peace was restored by his receiving Tavavich, daughter of Ras Ali, in marriage; and this lady is said to have been a good and wise counsellor during her lifetime. He next turned his arms against the Turks, in the direction of Massawa, but was defeated; and the mother of Ras Ali having insulted him in his fallen condition, he proclaimed his independence. As his power was increasing, to the detriment of both Ras Ali and Ubié, these two princes combined against him, but were heavily defeated by him at Gorgora (on the southern shore of Lake Tana) in 1853. Ubié retreated to Tigré, and Ras Ali fled to Begemeder, where he eventually died. Kassa now ruled in Amhara, but his ambition was to attain to supreme power, and after conquering Gojam and Tigré, he proclaimed himself negusa nagast of Ethiopia under the name of Theodore III. He now turned his attention to Shoa which still remained unsubdued.

**Struggle with Shoa.**—Retracing our steps for a moment in that direction, we find that in 1813 Sahale (or Sella) Selassie, younger son of the preceding ruler of Shoa, Wassen Seged, had proclaimed himself king of Ifat, Shoa and the Galla. His reign was long and beneficent, and by his wise measures and personal generosity, and by extending his hospitality to Europeans, he brought his country within the closer ken of civilized European powers. During his reign he received the missions or Major W. Cornwallis Harris, sent by the governor-general of India (1841), and M. Rochet d'Héricourt, sent by Louis Philippe (1843), with both of whom he concluded friendly treaties on behalf of their respective governments He was succeeded in 1847 by his eldest son, Haile Melikot, who, by increasing his dominions at the expense of the Galla, and by concluding a treaty with Ras Ali against Kassa in 1850 determined the latter to crush him at the earliest opportunity.

Thus it was that in 1855 Kassa, under the name of the emperor Theodore, advanced against Shoa with a large army. Dissensions broke out among the Shoans, and after a desperate and futile attack on Theodore at Debra-Berhan, Haile Melikot died of exhaustion and fever, nominating with his last breath his 11-year-old son Menelek as successor (Nov 1855) After a hard fight, Menelek was defeated and handed over to the negūs, taken to Gondar and there trained in Theodore's service.

**Decline of Power.**—Theodore had by then reached the zenith of his career. He is described as being generous to excess, free from cupidity, merciful to his vanquished enemies, and strictly continent, but subject to violent bursts of anger and possessed of unyielding pride and fanatical religious zeal. He was also a man of intelligence, superior to those among whom he lived, with natural talents for governing and gaining the esteem of others. He had, further, a noble bearing and majestic walk, a frame capable of enduring any amount of fatigue, and is said to have been "the best shot, the best spearman, the best runner, and the best horseman in Abyssinia." Unfortunately, success turned his head, and he lost certain good influences around him by the death of his good queen Tavavich, and the murder by rebels of his two English friends and advisers, W. C. Plowden and J. T Bell, whose deaths he avenged by the slaughter of 2,000 of the rebels

His union with his second wife, Terunish, the proud daughter of the late Ras of Tigré, was a most unhappy one. and he seems to have given himself over to intoxication and lust, and to have exercised the most terrible cruelty in his campaigns against the Galla and the various districts in which rebellions broke out against him. This exhausted his strength and resources, and such of the country as he still dominated groaned under his heavy exactions.

**Quarrel with Great Britain.**—In Oct. 1862, Captain Cameron, who had been appointed in Feb. of that year to succeed Mr. Plowden as British consul, was sent home by Theodore, with a letter to the queen of Great Britain, which reached the Foreign Office on Feb 12, 1863 This letter was put aside and no answer returned, and to this in no small degree are to be attributed the difficulties that subsequently arose with that country. In Nov. despatches were received from England, but no answer to the emperor's letter, and this, together with a visit paid by Captain Cameron to the Egyptian frontier town of Kassala, greatly offended him. Accordingly in Jan. 1864 Captain Cameron and his suite, with Messrs. Stern and Rosenthal, were cast into prison. When the news of this reached England, the government resolved, when too late, to send an answer to the emperor's letter, and selected Mr. Hormuzd Rassam to be its bearer. The British party on arrival at the king's camp in Damot, on Jan. 25, 1866, were received with all honour, and were afterwards sent to Kwarata, on Lake Tana, there to await the arrival of the captives. The latter reached Kwarata on March 12 and everything appeared to proceed favourably. A month later they started for the coast, but had not proceeded far when they were all brought back and put into confinement. The Europeans, although detained as prisoners, were not at first unkindly treated; but in the end of June they were sent to Magdala, where they were soon afterwards put in chains, suffered hunger, cold and misery, and were in constant fear of death. Meanwhile one of them, Mr. Flad, had been sent by Theodore with a letter to Queen Victoria, asking for European workmen and machinery, and with a view if possible to effect the release of the prisoners by conciliatory measures, Mr. Flad was sent back, with some artisans and machinery, and a letter from the queen, stating that these would be handed over to his majesty on the release of the prisoners and their return to Massawa. This, however, failed to influence the emperor, and the British Government at length saw that they must have recourse to arms.

**Sir Robert Napier's Expedition.**—In July 1867 it was resolved to send an army into Abyssinia to enforce the release of the captives, under Sir Robert Napier (1st Baron Napier of Magdala). The landing-place selected was Mulkutto (Zula), on Annesley Bay, the point of the coast nearest to the site of the ancient Adulis, and we are told that "the pioneers of the English expedition followed to some extent in the footsteps of the adventurous soldiers of Ptolemy, and met with a few faint traces of this old-world enterprise" (C. R Markham). The force amounted to upwards of 16,000 men, besides 12,640 belonging to the transport service, and followers, making in all upwards of 32,000 men. The task necessitated a march over 400 miles of a mountainous and little-known country, inhabited by savage tribes, to the camp or fortress of Theodore. The commander-in-chief landed on Jan. 7, 1868, and soon after the troops began to move forward through the pass of Senafé, and southward through the districts of Agamé, Tera, Endarta, Wojerat, Lasta and Wadela.

In the meantime the power of Theodore in the country was rapidly waning. Shoa had already shaken off his yoke; Gojam was virtually independent; Walkeit and Simen were under a rebel chief; and Lasta, Waag and the country about Lake Ashangi had submitted to Wagshum Gobassié, who had also overrun Tigré and appointed Dejaz Kassai his governor The latter, however, in 1867 rebelled against his master and assumed the supreme power of that province. At the time when the British troops made their appearance in the country Theodore had thus been reduced to great straits. His army, which at one time numbered over 100,000 men, was rapidly deserting him, and he could hardly obtain food for his followers. He resolved to quit his capital Debra-Tabor, which he burned, and set out with the remains of his army for Magdala. During this march he displayed an amount of engineering skill in the construction of roads, of military talent and fertility of resource, that excited the admiration and astonishment of his enemies. But after a heavy defeat near Magdala on April 10, Theodore sent Lieut. Prideaux, one of the captives, and Mr. Flad, accompanied by a native chief, to the British camp to sue for peace. Answer was returned, that if he would deliver up all the Europeans in his hands, and submit to the queen of Great Britain, he would receive honourable treatment. The captives were liberated and sent away, and accompanying a letter to the British general was a present of 1,000 cows and 500 sheep, the acceptance of which would, according to Eastern custom, imply that peace was granted. Through some misunderstanding, word was sent to Theodore that the present would be accepted, and he felt that he was now safe; but in the evening he learned that it had not been received, and despair again seized him. The next day, April 13, Magdala was stormed and taken, practically without loss, and within they found the dead body of the emperor, who had fallen by his own hand. The inhabitants and troops were subsequently sent away, the fortifications destroyed, and the town burned. The queen Terunish having expressed her wish to go back to her own country, accompanied the British army, but died during the march, and her son Alamayahu, the only legitimate son of the emperor, was brought to England, as this was the desire of his father.[1] The success of the expedition was in no small degree owing to the aid afforded by the several native chiefs through whose country it passed, and no one did more in this way than Dejaz Kassa or Kassai of Tigré. In acknowledgment of this, several pieces of ordnance, small arms and ammunition, with much of the surplus stores, were handed over to him, and the British troops left the country in May 1868.

## THE EMPEROR MENELEK II.

**Early Struggles as King of Shoa.**—It is now time to return to the story of the young prince Menelek, who, as we have seen, had been nominated by his late father as ruler of Shoa, but was in Theodore's power in Tigré. In 1865, he took advantage of Theodore's difficulties with the British government and escaped to Workitu, queen of the Wollo Galla country. The emperor, who held as hostage a son of Workitu, threatened to kill the boy unless Menelek were given up; but the gallant queen refused, and lost both her son and her throne. The fugitive meanwhile arrived safely in Shoa, and was there acclaimed as negüs. For the next three years Menelek devoted himself to strengthening and disciplining his army, to legislation, to building towns, such as Liché (near Debra-Berhan), Worra Hailu (Wollo Galla country), etc., and to repelling the incursions of the Galla On the death of Theodore (April 13, 1868) many Shoans, including Ras Dargé, were released, and Menelek began to feel himself strong enough to undertake offensive operations against the northern princes But these projects were of little avail, for Kassai of Tigré, had by this time (1872) risen to supreme power in the north With the help of the rifles and guns presented to him by the British, he had beaten Ras Bareya of Tigré, Wagshum Gobassié of Amhara and Tekla Giorgis of Gondar, and after proclaiming himself negusa nagast under the name of Johannes or John, was now preparing to march on Shoa. Here, however, Menelek was saved from probable destruction through the action of Egypt. This power had, by the advice of Werner Munzinger, then the Swiss governor of Massawa, seized and occupied in 1872 the northern province of Bogos, and, later on, insisted on occupying Hamasen also, for fear Bogos should be attacked John, after futile protests, collected an army, and with the assistance of Ras Walad Michael, hereditary chief of Bogos, advanced against the Egyptian forces, who were under the command of one Arendrup, a Dane. Meeting near the Mareb, the Egyptians were beaten in detail, and almost annihilated at Gundet (Nov. 13, 1875). An avenging expedition was prepared in the spring of the following year, and, numbering 14,000 men under Ratib Pasha, Loring (American), and Prince Hassan, advanced to Gura and fortified a position in the neighbourhood. Although reinforced by Walad Michael, who had now quarrelled with John, the Egyptians were a second time (March 25, 1876) heavily beaten by the Abyssinians, and retired, losing an enormous quantity of both men and rifles. Colonel C. G. Gordon, governor-general of the Sudan, was now ordered to go and make peace with John, but the king had moved south with his army, intending to punish Menelek for having raided Gondar whilst he, John, was engaged with the Egyptians. Menelek's kingdom was meanwhile torn in twain by serious dissensions on the subject of the succession, but on the approach of John, the Shoans united for a time against their common enemy. After a few skirmishes, however, they melted away, and Menelek was obliged to submit and do obeisance to John. The latter behaved with much generosity, but at the same time imposed terms which effectually deprived Shoa of her independence (March 1878). In 1879 Gordon was sent on a fresh mission to John on behalf of Egypt; but he was treated with scant courtesy, and was obliged to leave the country without achieving anything permanent.

**Advent of the Italians.**—The Italians now come on the scene. Assab, a port near the southern entrance of the Red Sea, had been bought from the local sultan in March 1870 by an Italian company, which, after acquiring more land in 1879 and 1880, was bought out by the Italian Government in 1882. In this year Count Pietro Antonelli was despatched to Shoa in order to improve the prospects of the colony by treaties with Menelek and the sultan of Aussa; but both John and Menelek became uneasy when Beilul, a port to the north of Assab Bay, was occupied by the Italians in Jan. 1885, and Massawa taken over by them from Egypt in the following month. This latter act was greatly resented by the Abyssinians, for by a treaty concluded with a British and Egyptian mission under Admiral Hewett and Mason Pasha in the previous year, free transit of goods was to be allowed through this port. In Jan. 1887, the Abyssinians, in consequence of a refusal from General Gené to withdraw his troops, surrounded and attacked a detachment of 500 Italian troops at Dogali, killing more than 400 of them Reinforcements were sent from Italy, whilst in the autumn the British Government stepped in and tried to mediate by means of a mission under Mr. (afterwards Sir Gerald) Portal. His mission, however, proved abortive, and after many difficulties and dangers he returned to Egypt at

[1] He was subsequently sent to school at Rugby, but died in his 19th year, on Nov. 14, 1879. He was buried at St. George's Chapel, Windsor.

the end of the year. John was killed in battle against the dervishes in March 1889, when Menelek immediately claimed the Empire of Abyssinia. The new emperor brought Abyssinia for the first time under a single rule, doubled the size of the Empire by extensive conquests, and began development on European lines.

The Italian envoy Count Antonelli was with Menelek when he claimed the throne, and promptly concluded with him (May 2, 1889) on behalf of Italy a friendly treaty, to be known hereafter as the famous Uccialli treaty. In consequence of this the Italians occupied Asmara, made friends with Mangasha, reputed son and heir of King John, and received Ras Makonnen (Ras of Harar, which province had been conquered by Menelek in Jan. 1887), Menelek's nephew, as his plenipotentiary in Italy; thus it seemed as though hostilities between the two countries had come to a definite end. As, however, the Italians became more and more friendly with Mangasha and Tigré the apprehensions of Menelek increased, till at last, in Feb. 1893, he wrote denouncing the Uccialli treaty, which differed in the Italian and Amharic versions. According to the former, the negūs was bound to make use of Italy as a channel for communicating with other powers, whereas the Amharic version left it optional. Meanwhile the dervishes were threatening Eritrea. A fine action by Colonel Arimondi gained Agordat for Italy (Dec. 21, 1893), and a brilliant march by Colonel Baratieri resulted in the acquisition of Kassala (July 17, 1894).

**War with Italy.**—On his return Baratieri found that Mangasha was intriguing with the dervishes, and had actually crossed the frontier with a large army. At Koatit and Senafé (Jan. 13–15, 1895) Mangasha was met and heavily defeated by Baratieri, who occupied Adigrat in March. But as the year wore on the Italian commander pushed his forces unsupported too far to the south. Menelek was advancing with a large army in national support of Mangasha, and the subsequent reverses at Amba-Alagi (Dec. 7, 1895) and Makale (Jan. 21, 1896) forced the Italians to fall back.

Reinforcements of many thousands were meanwhile arriving at Massawa, and in Feb. 1896 Baratieri took the field at the head of over 13,000 men. Menelek's army, amounting to about 90,000, had during this time advanced, and was occupying a strong position at Abba Garima, near Aduwa (or Adowa). Here Baratieri attacked him on March 1, but the difficulties of the country were great, and one of the four Italian brigades had pushed too far forward. This brigade was attacked by overwhelming numbers, and on the remaining brigades advancing in support, they were successively cut to pieces by the encircling masses of the enemy. The Italians lost 4,600 white and nearly 3,000 native troops killed and wounded; the number of prisoners was estimated at between 2,500 and 3,000. The Abyssinians' casualties were far greater. General Baldassera advanced with a large body of reinforcements to avenge this defeat, but, beyond the peaceful relief of Adigrat no further operations took place. On Oct. 26 following, a provisional treaty of peace was concluded at Addis Ababa, annulling the treaty of Uccialli and recognizing the absolute independence of Abyssinia. (*See* ITALY: *History* and SOMALILAND.)

**Consolidation and Extension of the Empire.**—The war, so disastrous to Italy, attracted the attention of all Europe to Abyssinia and its monarch, and numerous missions, two Russian, three French, and one British, were despatched to the country, and hospitably received by Menelek. The British one, under Mr. Rennell Rodd (later Lord Rennell), concluded a friendly treaty with Abyssinia (May 15, 1897).

In 1898 Menelek subdued Mangasha and later conducted a number of expeditions in different parts of the country, notably against the Galla, and added immense provinces to the empire. An important treaty was concluded on May 15, 1902, between England and Abyssinia for the delimitation of the Sudan-Abyssinian frontier. Menelek, in addition, agreed not to obstruct the waters of Lake Tana, the Blue Nile or the Sobat, so as not to interfere with Nile irrigation. A combined British-Abyssinian expedition (Mr. A. E. Butter's) was dispatched in 1901 to propose and survey a boundary between Abyssinia on the one side and British East Africa and Uganda on the other; and the report of the expedition was made public by the British Government in Nov. 1904. It was followed in 1908 by an agreement defining the frontiers concerned. It is also an interesting fact that between 1899 and 1904 the Abyssinians co-operated with the British in their campaigns against the "Mad Mullah" of Somaliland by sending joint expeditions on no less than four occasions.

**Growth of European Influence.**—The first concession for a railway was the one from the coast at Jibuti (French Somaliland) to the interior, granted by Menelek to a French company in 1894. Difficulties arose over the continuation of the railway to Addis Ababa and beyond, and the proposed internationalization of the line. These difficulties, which hindered the work of construction for years, were composed (so far as the European Powers interested were concerned) in 1906 by the terms of an Anglo-French-Italian agreement, signed in London on Dec. 13 of that year.

Meanwhile the country slowly developed in parts and opened out cautiously to European influences and most of the Powers appointed representatives at Menelek's capital, the British minister-plenipotentiary and consul-general, Lieut.-Colonel Sir J. L. Harrington, having been appointed shortly after the British mission in 1897. But Ras Makonnen, the most capable and civilized of Menelek's probable successors, died in March 1906, and Mangasha died later in the same year; the question of the succession therefore opened up the possibility that, in spite of recent civilizing influences, Abyssinia might still relapse in the future into its old state of conflict. The Anglo-French-Italian agreement of Dec. 1906, referred to above, contained provisions in view of this contingency. The preamble of the document declared that it was the common interest of the three Powers "to maintain intact the integrity of Ethiopia," and Article I. provided for their co-operation in maintaining "the political and territorial *status quo* in Ethiopia." Should, however, the *status quo* be disturbed, the Powers were to concert to safeguard their special interests. The terms of the agreement were settled in July 1906, and its text forthwith communicated to the negūs. (E. GL.; C. F. R.)

**From 1908 to the War with Italy.**—For the first 8 of these years (1908–1916) chaos reigned, *i. e.*, during the regency of Menelek's widow Taitu and Ras Tessama, and the rule of the Emperor Lej Yasu; during the next 12 years, 1916–1928—the period of combined rule of Menelek's daughter Zauditu as Empress with Ras Tafari (later the Emperor Haile Selassie) as Regent—matters improved to some extent in spite of constant intrigue between the progressive party, supporting the Regent, and the reactionary elements led by the Empress; during the last 8 years Tafari, first of all as King (1928–1930), later as Emperor (1930–1936), had begun to introduce a measure of reform and progress into his backward and unruly empire.

**First Period—1908–1916.**—Menelek had in 1908 nominated as his successor Lej Yasu (born 1896) under the regency of one of the more enlightened Abyssinian chieftains, Ras Tessama. But the constant strife between Menelek's wife Taitu, the Regent, and the boy Emperor, made ordered government impossible. The enforced retirement of Taitu in 1910, the death of Tessama in 1911, and the complete assumption of power in that year by Yasu, merely drove matters from bad to worse.

By his misgovernment, his tyrannical and dissolute conduct, and particularly by his inclination to Islam, Lej Yasu mortally affronted his own subjects, intensely proud as they were and are of their 15 centuries of Christian tradition. His support of the "Mad Mullah" of Somaliland, who claimed him as a cousin, and his efforts to build up a federation of Muslim states, anti-ally in its sentiments, also estranged the sympathies of the three great Powers with possessions bordering on Abyssinia. In September, 1916, he was excommunicated by the Abuna, the head of the Abyssinian Church. The great Rases, thus relieved of their oath of fealty, formally deposed him, and proclaimed Zauditu, a daughter of the Emperor Menelek, born in 1876, as Empress, and Dajazmach Tafari, born July 17, 1891, son of Menelek's nephew, Ras Makonnen, as Regent of the empire, heir to the throne and Ras of Rases. Heavy fighting followed. Lej Yasu's father, Ras Mikael of Wollo Galla, raised large Galla forces to aid his son, but the troops of the deposed ruler were defeated with great slaughter at Sagalle on October 27, 1916. Ras Mikael was taken prisoner, and

Lej Yasu became a wanderer, first of all in the Danakil country and later in the province of Tigré. He was taken prisoner by Tafari in 1921, and kept in chains until his death in 1935.

**Second Period—1916–1928.**—The dual nature of the administration of empress and regent stimulated intrigue among the powerful Rases and provincial governors, who had fallen back into a state of semi-independence during the preceding years of misrule, and made effective control difficult to exercise. In spite of this, however, and of sporadic fighting with Lej Yasu's followers, Ras Tafari made substantial progress in administrative improvement; he was, however, hampered by a thoroughly bad and ineffective, though onerous, financial system, and an entire absence of men of integrity and ability to support and execute his ideas.

His distrust of the intentions of the great European limitrophe powers—England, France, and Italy—made him slow to grant concessions to or to accept financial or advisory assistance from nationals of these powers, and this further hindered development. It was largely on account of this distrust of his neighbours that Ras Tafari strove for the admission of Abyssinia to the League of Nations, which he achieved in 1923. This step was criticized as being premature in view of the backward state of development of the country, and was, in fact, opposed at first by the British representatives but ultimately approved, largely owing to the strong support accorded by the French.

Feeling more secure both internally and externally, as a result of the League membership, Ras Tafari felt able to leave Abyssinia and visit the principal European countries in 1924. Shortly afterward he appealed to the League against the Anglo-Italian agreement regarding spheres of influence in Abyssinia, concluded in December 1925, which he regarded as a violation of Abyssinian rights A visit of the duke of Abruzzi to Addis Ababa in 1927 was followed by the signature during the following year of an Italo-Abyssinian arbitration treaty of "perpetual friendship," and of a further agreement between the two countries providing for the cession to Abyssinia of the port of Assab, and for the construction of a road thence to the capital. This instrument, however, was neither published nor implemented.

Meanwhile, on October 7, 1928, Tafari caused himself to be proclaimed king with all power in his hands, leaving Zauditu to retain a nominal position as empress. On April 3, 1930, Zauditu died, and on November 2 of that year Tafari was crowned emperor.

**Third Period—1928–1936.**—From the moment when Ras Tafari assumed full power in 1928 he worked unceasingly and with a greater measure of success than before for the development of Abyssinia. Progress was, however, slow in view of the factors already described, which still existed albeit to a lesser extent. Such administrative reforms as were introduced, *e.g.*, the establishment of ministries, and the creation of a "parliament," were more theoretical than real, and had little actual effect, all power remaining, in fact, in the hands of the emperor, who however, added to his effective control of the country by removing the last of the hereditary provincial governors, Ras Hailu of Gojam, who led a rebellion against him in 1932 in favour of the deposed emperor Lej Yasu. Minor reforms in the way of educational institutions, road construction, etc., were carried out; but the financial system remained practically untouched.

Strengthened in his belief that the external position of Abyssinia was safeguarded by membership in the League of Nations, the emperor manifested little inclination to meet the views of Italy, which country was pressing for development on the lines of the Anglo-Italian Agreement of 1925 and otherwise, and was engaged in ever increasing activity in Eritrea, Italian Somaliland and along the Red sea generally.

**The Outbreak of the War with Italy.**—Wal Wal, an obscure village near the ill-defined Abyssinian-Italian Somaliland frontier, although placed in Abyssinia by most maps, had been occupied by Italian troops for several years without protest from Abyssinia. The Anglo-Abyssinian frontier delimitation commission, escorted by a force of Abyssinian troops, arrived there on November 23 1934 and came into touch with the Italians, owing to whose attitude the British mission withdrew. Italian and Abyssinian troops remained facing each other at Wal Wal until on December 5, 1934, firing took place; nine months later, in Sept 1935, the arbitrators appointed by the League of Nations agreed unanimously that neither side was guilty of aggression.

As the gravity of the issues likely to be raised by this incident became apparent, strenuous efforts to maintain peace were made by various countries, notably by England, both directly and through the machinery of the League of Nations. In Dec. 1934, Abyssinia had notified the League of Nations of the Wal Wal incident, and had appealed for League intervention under Article XI of the Covenant in Jan. 1935. In that month the two countries ostensibly agreed to seek a settlement; but, no agreement having been reached by March, Abyssinia invoked Article XV, and later demanded arbitration under the treaty with Italy of 1928.

A conference between England, France and Italy was held in Paris on August 15 to 18 but they failed to find any basis of agreement A committee of five, appointed by the League of Nations on Sept. 6 to formulate proposals, reported on the 18th; Abyssinia agreed to open negotiations on the basis of these proposals but Italy refused them. Then, when war broke out on October 3, the League condemned Italy as the aggressor, and proceeded to elaborate in October, and put in force on November 18, 1935, a scheme of financial and economic "sanctions" against Italy.

Bitter feeling was aroused in Italy by these measures, and the international aspect of the situation was rendered more delicate owing to the dispatch by Italy in September of large reinforcements to Libya; which was followed by the sending to Egypt by England of considerable numbers of troops and much war material, and the strengthening of the British fleet in the Mediterranean.

On November 6, the League committee of eighteen had adopted a resolution in favour of oil, steel and coal sanctions, and on November 25 this was supported by Rumania and Russia. But on December 13, the committee adjourned further consideration of the proposed oil sanction, which in fact was never imposed. No country appeared to be willing to consider the imposition of military sanctions.

Proposals for a peace settlement on the basis of certain territorial cessions by Abyssinia to Italy were formulated between Sir Samuel Hoare, British foreign secretary, and Pierre Laval, representing France, on December 8; submitted to Abyssinia on the 10th; and published on December 13. These had been approved by the British government, which, however, abandoned them on December 18 in view of the strong adverse public opinion in England.

On March 3, 1936 the League committee of thirteen issued an appeal to both belligerents to cease hostilities. This, however, was unavailing, and on April 20 the League council adjourned until May 11, by which time the war was over. At the session held during the week commencing June 29 (which was addressed by Emperor Haile Selassie in person) the League decided to recommend the raising of the sanctions which had been imposed on Italy as these had failed to achieve their purpose, but refused to recognize the Italian occupation of Abyssinia. Sanctions were raised in July. After that, several of the powers previously represented in Abyssinia by legations replaced them by consulates, tacitly admitting the change in status, although no general or specific recognition of Italy's possession had been given. (C. F. R.)

## FROM ITALIAN AGGRESSION TO THE NEW INDEPENDENCE

**Military Operations.**—During the period of negotiations, Italy utilized the first nine months of 1935 in equipping and assembling a large army in Eritrea and Somaliland, so that it started the campaign well prepared and with an immense superiority in every form of modern armament. The Abyssinians, to avoid any appearance of provocation, ordered mobilization only after Italian troops had crossed the frontier, without any official declaration of war, on Oct. 3. The Abyssinians were completely inferior in equipment especially because the democratic powers had again and again refused the demands of the emperor to be allowed to buy modern armaments. Thus the Italians, moving from Eritrea in the north and from Somaliland in the south, under General de Bono, who had been appointed commander in chief in Jan. 1935, had an easy task. Nevertheless it took them, in spite of their technical superiority and the general backwardness of Ethiopian organization, seven months to defeat the Ethiopian forces. As a result of slow progress General de Bono, an old time fascist, was replaced on Nov. 28 by General Badoglio. Nor was General Graziani, commanding the southern army, more successful. He could take the principal town of that part, Harar, only on May 8, while the northern army entered the capital, Addis Ababa, on May 5, 1936. The emperor

had flown on the night of May 1, and sailed via Palestine to Europe where he arrived in England.

**Italian Domination.**—Italy annexed Abyssinia on May 9, 1936, and the king of Italy was proclaimed emperor of Abyssinia. On June 1, 1936, the colony of Italian East Africa (Africa Orientale Italiana) was created comprising Abyssinia Eritrea and Italian Somaliland under one viceroy and divided into five provinces Eritrea with the capital of Asmara, Amhara with the capital of Gondar; Galla with the capital of Jimma, Harar with the capital of the same name, Somaliland with the capital of Mogadishu. A sixth province, Shoa, was later added. Each province was under a governor. The whole area was 665,977 sq mi with 12,100,000 inhabitants in 1939. The capital, Addis Ababa, with about 150,000 inhabitants, formed a district of its own.

The Italian occupation of the country was placed first under Marshal Badoglio as viceroy who, however, was succeeded after a few weeks by Marsha. Graziani. On Nov. 20, 1937, Prince Amedeo of Savoy, duke of Aosta, became viceroy The Italian administration tried to improve the economic production of the country and built a number of good motor roads Yet in spite of very large Italian forces maintained in the country, the Abyssinians continued to fight for their independence. Unrest did not subside for some of the less accessible parts of the country, and it was kept alive by the cruel methods which the fascists applied. In March 1937 bombs were thrown at Addis Ababa which wounded the viceroy. As a result the Italians established a reign of terror and thousands of natives were massacred and executed. Though a number of Italian settlers were brought to Ethiopia, the country in no way fulfilled the great economic expectations which the fascists had heralded to the world in 1935 By the beginning of 1939 the Italian fascists raised the demand for the annexation of French Somaliland with the port of Djibouti, to Italian East Africa

**Abyssinia in World War II.**—With the outbreak of World War II in 1939 the importance of Abyssinia for Italian strategy increased considerably, because it was generally supposed, as the fascists had often given to understand, that, in case of Italy's entrance into the conflict, Italian armies from Libya and Abyssinia would take the British position in Egypt and the Sudan into a great pincer movement and thus definitely establish the longed-for great Italian empire. On May 9, 1940, the anniversary of the proclamation of the new empire, bellicose and boastful speeches were made by the fascists in Rome and Count Grandi declared that the Italian people "powerful in its arms, strong in its right, conscious of its mission, formed from the Alps to the Indian ocean a compact army of 45,000,000 soldiers." When on June 10 Italy declared war against "the plutocratic and reactionary democracies of the west," it became however, quickly clear how unfounded the fascist boasts had been and on how weak feet of clay the proud Italian empire in Abyssinia was built.

The complete inefficiency of the numerically superior Italian naval forces in the Mediterranean, which for the first year of the war left the control of the sea in British hands, was responsible for the cutting off of the Italian army in Abyssinia from home supply. Nevertheless there was a very considerable Italian army in Abyssinia, magnificently equipped, at least on paper. (*See* WORLD WAR II.)

**The Liberation of Abyssinia.**—On July 12, 1940, the British government officially recognized Ethiopia as an ally and promised its liberation in case of victory. Emperor Haile Selassie left Great Britain in the same month and began to organize Ethiopian resistance from the Sudan. It is true that the Italians, as a result of their great numerical superiority, were able to occupy, in Aug. 1940, British Somaliland. But soon the tide was to turn. The Italians had to abandon Kassala, the only town in the Sudan near the frontier, which they succeeded in occupying in 1940. On Jan. 15, 1941 Emperor Haile Selassie crossed the border into Ethiopia; patriot forces began to gather around him and played an important role in the liberation of their country A British army under General Sir Alan Gordon Cunningham moved from the south into Italian Somaliland The operations started by the end of January and by the end of March not only had the whole of Italian Somaliland been captured, but also British Somaliland reconquered.

Meanwhile British forces from the Sudan, who under General Platt had entered Eritrea, had made their victory secure by the capture of Cheren on March 27, and of Asmara on March 31. The patriot armies under the emperor had approached from Debra Markos the centre of the country which was threatened simultaneously from the south by General Cunningham's quick advance On April 6 the capital, Addis Ababa, was in British hands The Italian troops under the duke of Aosta withdrew to the north and resisted for a few weeks longer before they surrendered at Amba Alagi on May 19. Two major pockets of resistance remained, at Jimma in the south under General Pietro Gazzera and at Gondar in the north under General Guglielmo Nasi. The last to surrender was that at Gondar. This fortified position was taken by storm by patriot troops on Nov. 27. Thus the war ended in a complete disaster for fascist Italy, the dream of empire had gone, the hated Italian domination of Abyssinia was over and the liberty of the ancient empire could be restored. More than 100,000 Italians were taken prisoners, among them the duke of Aosta. The British victory made the Suez canal safe from attack from the south, and opened the Red sea to American shipments for Egypt and the middle east. In Dec. 1941 the American government began to build a great supply base in Eritrea.

On May 5, 1941 Emperor Haile Selassie re-entered Addis Ababa, exactly five years after the Italians had occupied the city. He had been the first of the heads of state expelled by the fascist conquerors and forced to go into exile. He was also the first to return. As a legacy from the time of the Italian occupation he found a modernized capital and much improvement in road communications which with British help will facilitate the modernization of Abyssinia's administration, the great task set before the emperor For a transitory period a dual British and Abyssinian control was instituted There were about 40,000 Italian civilians in the country. It should be pointed out that in spite of the easily understandable feelings of the Ethiopians against their fascist oppressors, no serious disorders occurred and the Italian civilians continued their occupations peacefully until circumstances made their evacuation possible.

On Feb 3, 1942 the British foreign secretary announced the conclusion of a two-power pact between Britain and Abyssinia which provided for a British military mission and British advisers to the emperor, a loan of $10,000,000 and the presence of British judges in Ethiopian courts. R G Howe was appointed British minister to Abyssinia, and at the end of Aug. 1942 the Abyssinian minister, Ayalla Gabre, arrived in London. At the same time all British troops left Abyssinia, as the pacification of the country had been completed and the new native administration firmly established. (H Ko.)

*See* James Bruce, *Travels to Discover the Source of the Nile* (1790), A. B Wylde, *Modern Abyssinia* (1901), a valuable volume, Powell-Cotton, *A Sporting Trip through Abyssinia* (1902), Duchesne-Fournet, *Mission en Ethiopie* (1909), which contains a useful bibliography G Montandon, *Au pays Ghimirra* (Neuchâtel, 1913), C. Rathjens, *In Abissinia* (1914); L de Castro, *Nella Terra dei Negus* (1915), a good general description, Major Maydon, *Simen, its Heights and Abysses* (1925), on the mountainous northern country; C. F. Rey, *Unconventional Abyssinia as it is Today* (1923) and *In the Country of the Blue Nile* (1927), two books embodying a comprehensive study of the country as the result of four journeys there; Arnold Hodson, *Seven Years in Southern Abyssinia* (1927), a valuable record of borderland difficulties; C. F Rey, *The Real Abyssinia* (1935), a comprehensive description up to war with Italy

For geographical information, *see* the *Geographical Journal* (London)—H Weld Blundell, "A Journey through Abyssinia" (vol xv, 1900) and "Exploration in the Abbai Basin" (vol. xxvii, 1906), Arnold Hodson, "Southern Abyssinia" (Feb. 1919) and "Notes on Abyssinian Lakes" (July 1922); Major Athill, "Through S W. Abyssinia to the Nile" (Nov. 1920); C. F Rey, "Abyssinia of To-day" (Sept. 1922) and "A Visit to Gudrn and Gojam" (June 1926).

For history, *see* the Hakluyt Society's translation of *The Portuguese Expedition to Abyssinia* (1902); Handbook No 29 prepared by the historical section of the foreign office (1920); Sir E Hertslet's *Map of Africa by Treaty* for treaties up to 1896; Sir E. W. Budge, *A History of Ethiopia* (1928); C. F. Rey, *The Romance of the Portuguese in Abyssinia* (1929).

Political questions are referred to by H Le Roux, *Menelik et nous* (1901); Charles Michel, *La Question d'Ethiopie* (1905); T. Lennox Gilmour, *The Ethiopian Railway and the Powers* (1906); Pierre Alype, *L'Ethiopie et les convoitises allemandes* (1917) and *L'Empire du Negus* (1924), G. E. Underhill, in the *Quarterly Review* (Jan. 1922), C. F. Rey, *Edinburgh Review* (Oct. 1926).

**ABYSSINIAN CHURCH.** As the chronicle of Axum relates, Christianity was adopted in Abyssinia in the 4th century. About A.D. 330 Frumentius was made first bishop of Ethiopia by Athanasius, patriarch of Alexandria. Little is known of church history down to the period of Jesuit rule, which broke the connection with Egypt from about 1500 to 1633.

Early in the 16th century the church was brought under the influence of a Portuguese mission. The initiative in the Roman Catholic missions to Abyssinia was taken by Portugal, as an incident in the struggle with the Muslims for the command of the trade route to India by the Red sea. In 1507 Matthew, or Matheus, an Armenian, had been sent as Abyssinian envoy to Portugal to ask aid against the Muslims, and in 1520 an embassy under Dom Rodrigo de Lima landed in Abyssinia.

Generally the Abyssinians agree with the Copts in ritual and practice (*see* COPTS). The Septuagint was translated into the literary language, which is used for all services, though hardly understood. Saints and angels are highly revered, if not adored, but graven images are forbidden. Fasts are long and rigid. Confession and absolution, strictly enforced give great power to the priesthood. Pilgrimage to Jerusalem is a religious duty and covers many sins.

For an account written shortly before World War I see Dowling, *The Abyssinian Church* (1909). The account of Alvarez was translated and edited for the Hakluyt Society by Lord Stanley of Alderley under the title *Narrative of the Portuguese Embassy to Abyssinia* (1881).

With reference to present social and political conditions, *see* ABYSSINIA. On the architecture, *see* J. C. Hotten, *Abyssinia Described* (1868), and (especially with reference to monuments of heathen origin) Bent, *The Sacred City of the Ethiopians* (1896).

**ACACIA,** a genus of trees and shrubs belonging to the pulse or pea family (Leguminosae, sub-family Mimosoideae), comprises a group of about 550 species widely distributed over the warmer regions of the world, but particularly abundant in Australia and Africa. The leaves are usually twice compounded (bipinnate, *see* fig.); in some instances, notably with Australian species indigenous to arid localities, the leaflets are suppressed, their stalks (petioles) then becoming flattened and acquiring the physiological functions of leaves. These stalks are commonly vertically disposed, an orientation which precludes the inception of intense sunlight, thus apparently preventing injury through the retardation of excessive surface evaporation. The small, frequently fragrant flowers are arranged in rounded or elongated clusters. The several seeded pod-like fruits are either flattened or cylindrical, often with constrictions between the seeds. Sharp spines arm the branchlets of many forms.



FLOWERING BRANCH AND POD OF ACACIA SENEGAL, ONE OF 550 SPECIES OF ACACIA WIDELY DISTRIBUTED IN WARM REGIONS; A SENEGAL PRODUCES GUM ARABIC

True gum arabic is the product of *Acacia senegal,* a native of both east and west tropical Africa. The Indian *A. arabica* yields a similar gum, but of inferior quality. Catechu (*q.v.*) or cutch is procured from *A. catechu* and several other species. Extractions from finely divided wood of this tree are employed in dyeing khaki cloth.

The barks of most acacias are rich in tannin. *Babul* or *babool,* derived from *A. arabica,* is used in northern India for tanning. The Australian wattle barks, but especially golden wattle (*A. pycnantha*), silver wattle (*A. dealbata*), and tan wattle (*A. decurrens*), are important sources of tannin and collectively form an important article of export. The fruit pods of neb-neb (*A. nilotica*) and other African species are other sources of this astringent. Seeds of the South American *A. niopo* are processed and used as snuff.

A few acacias are productive of valuable timber. Australian blackwood (*A. melanoxylon*) is a highly figured wood of cabinet rank. Myall (*A homalophylla,* also Australian) yields a fragrant, decorative wood. Koa (*A. koa*), a native of the Sandwich Islands, produces a handsomely figured wood known to many through its use in the manufacture of ukuleles. *A. heterophylla* from Mauritius and Bourbon is another excellent timber tree. The biblical shittah tree (*A. seyal*) is also a member of this group Species noted for their heavily developed spines include the Australian kangaroo-thorn (*A. armata*), the African camel-thorn (*A. giraffae*), and the Central American bull-thorn acacia (*A. sphaerocephala*). The large thorn-like stipules of *A. spadicigera* (Central America) are hollow and provide shelter for ants which feed on leaf-stalk secretions and curious food-bodies at the tips of leaflets. Sweet acacia (*A. farensiana*) of the southwestern United States has been introduced into India and southern Europe Its fragrant, yellow flowers are used in making perfume.

The term acacia has been applied to species of the genus *Robinia* (*q.v.*), also a member of the Leguminosae. The American black locust (*Robinia pseudoacacia*) is the false acacia so widely cultivated in milder parts of Britain. (E. S. HR.)

**ACADÉMIE NATIONALE DE MUSIQUE,** the official title of the Paris Opéra, also known as the Théâtre National de l'Opéra, founded by Louis XIV in 1669 and the most famous institution of its kind in the world. Lully, an Italian by birth but naturalized as a Frenchman, was the first composer of note associated with the Académie, of which he obtained control in 1672. Later Rameau became director and produced there nearly all of his many operas, and he was succeeded by Gluck as ruling spirit with Piccinni as his rival. Other eminent composers prominently identified with the Paris Opéra subsequently included Spontini, Cherubini, Rossini, Meyerbeer, Auber, Gounod, Saint-Saëns and Massenet. The present building of the Paris Opéra, opened in 1875 and one of the most magnificent of its kind in existence, succeeded two others, both of which were destroyed by fire. Closely associated with the Paris Opéra is the Conservatoire de Musique, founded in 1784 under the name École royale de chant et de déclamation for the purpose of training opera singers and later widened in scope to include musical teaching and training of every kind.

**ACADEMIES.** The word "academy" is derived from "the olive grove of Academe, Plato's retirement" (*see* under ACADEMY, GREEK). The schools of Athens after the model of the Academy continued to flourish almost without a break for nine centuries till they were abolished by a decree of Justinian "Academy," in its modern acceptation, may be defined as a society or corporate body having for its object the cultivation and promotion of literature, of science and of art, either severally or in combination, undertaken for the pure love of these pursuits, with no interested motive. Modern academies, moreover, have, almost without exception, some form of public recognition; they are either founded, endowed or subsidized, or at least patronized, by the supreme head of the State. The term "academy" has been loosely used in modern times. In the 18th century it was frequently adopted by schools run by dissenters, and the name is often found attached to the public schools in Scotland and Northern Ireland We are only concerned here, however, with those institutions which are of historical importance in their various spheres.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A RENAISSANCE CONCEPTION OF A GREEK ACADEMY. FROM A 16TH CENTURY WOODCUT BY FRANCESCO MARCOLINI AFTER THE PAINTING, "THE ACADEMY OF KNOWLEDGE," BY GIUSEPPE PORTA

The first academy, as thus defined, though it might with equal justice claim to be the first of universities, was the museum of Alexandria founded at the beginning of the 3rd century B C. by the first of the Ptolemies. There all the sciences then known were pur-

sued, and the most learned men of Greece and of the East gathered. Here, too, was the nucleus of the famous library of Alexandria. Modern literary academies may be said to trace their lineage in direct descent from the troubadours of the early 14th century. The first floral games were held at Toulouse in May, 1324, at the summons of a gild of troubadours, who invited "honourable lords, friends and companions who possess the science whence spring joy, pleasure, good sense, merit and politeness" to assemble in their garden of the "gay science" and recite their works. These floral games survived till about the year 1500 In 1694 the *Académie des Jeux Floraux* was constituted an academy by letters patent of Louis XIV. Suppressed during the Revolution it was revived in 1806, and still continues to award amaranths of gold and silver lilies, for which there is keen competition.

Provence led the way, but Italy of the Renaissance is the soil in which academies most grew and flourished. The *Accademia Pontaniana,* to give it its subsequent title, was founded at Florence in 1433 by Antonio Beccadelli of Palermo and fostered by Laurentius Valla. Far more famous was the *Accademia Platonica,* founded *c.* 1442 by Cosimo de' Medici, which numbered among its members Marsilio Ficino, Pico della Mirandola, Machiavelli and Angelo Poliziano. It was, as the name implies, chiefly occupied with Plato, but it added to its objects the study of Dante and the purification of the Italian language, and though it lived for barely half a century yet its influence as a model for similar learned societies was great and lasting.

## I. SCIENTIFIC ACADEMIES

**Austria.**—The *Akademie der Wissenschaften* at Vienna, originally projected by Leibnitz, was founded by the emperor Ferdinand I. in 1846, and has two classes—mathematics and natural science, and history and philology.

**Belgium and the Netherlands.**—A literary society founded at Brussels in 1769 by Count Charles de Cobenzl, minister plenipotentiary of Maria Theresa, became in 1816 the *Académie royale des sciences et des Beaux-Arts de Belgique*, under the patronage of William I of the Netherlands. In 1834 it became *Académie Royale de Belgique*, while the Dutch portion took the name of the *Koninklijk Nederlander Institut.* The Royal Institute of the Low Countries was founded in 1808 by King Louis Bonaparte It was replaced in 1851 by the *Koninklijke Akademie van Wetenschappen* at Amsterdam, to which in 1856 a literary section was added.

**Denmark.**—The *Kongelige danske videnskabernes selskab* (Royal Academy of Sciences) at Copenhagen owes its origin to Christian VI. (1742). It developed into a sort of learned club. The king took it under his protection, enlarged its scope by the addition of natural history, physics and mathematics, and in 1743 constituted it a royal academy with an endowment fund.

**France.**—The old *Académie des sciences* had the same origin as the more celebrated *Académie française.* A number of men of science had for some 30 years met together. They included Descartes, Gassendi, Blaise and Etienne Pascal. Hobbes, the author of *Leviathan,* was presented to it during his first visit to Paris in 1640. Colbert conceived the idea of giving an official status to this learned club. A number of chemists, physicians, anatomists and eminent mathematicians—among whom were Christian Huyghens and Bernard Frenicle de Bessy (1605–75), the author of a famous treatise on magic squares—were chosen to form the nucleus of the new society. Pensions were granted by Louis XIV. to each of the members, and a fund for instruments and experiment was placed at their disposal. They began their session on Dec. 22, 1666, in the royal library. At first the academy was rather a laboratory and observatory than an academy proper. Several foreign *savants,* in particular the Danish astronomer Roemer, joined the society; and the German physician and geometer, Tschirnhausen, and Sir Isaac Newton were made foreign associates. After the death of Colbert the labours of the academicians were diverted from the pursuit of pure science to such works as the construction of fountains and cascades at Versailles, and the mathematicians were employed to calculate the odds of the games of lansquenet and basset. In 1699 the academy was reconstituted. By its new constitution it consisted of 25 members, ten honorary, men of high rank interested in science, and 15 pensionaries, who were the working members. Of these three were geometricians, three astronomers, three mechanicians, three anatomists and three chemists Each of these three had two associates, and, besides, each pensionary had the privilege of naming a pupil. There were eight foreign and four free associates. The constitution was purely aristocratical, differing in that respect from that of the French Academy, in which the principle of equality among the members was never violated. The leading spirits of the academy at this period were Clairault, Réaumur and Fontenelle, the popularizer of science. In the 18th century other prominent members were Laplace, Buffon, Lagrange, D'Alembert, Lavoisier and Jussieu, the father of modern botany It was suppressed on April 8, 1793.

In 1795 the Convention decided on founding an *Institut National* which was to replace all the academies. In 1816 the *Académie des sciences* was reconstituted as a branch of the Institute. The new academy has reckoned among its members, besides many other brilliant men, Carnot the engineer, the physicists Fresnel, Ampère, Arago, Biot, the chemists Gay-Lussac and Thénard, the zoologists G. Cuvier and the two Geoffroy Saint-Hilaires. In France there were also academies in most of the large towns. Montpellier, for example, had a royal academy of sciences, founded in 1706 by Louis XIV , reconstituted in 1847, and organized under three sections—medicine, science and letters There were analogous institutions at Toulouse, Nîmes, Arles, Lyons, Dijon, Bordeaux and elsewhere.

**Germany.**—The *Collegium Curiosum* was a scientific society, founded by J. C. Sturm, professor in the University of Altorf, in Franconia, in 1672, on the plan of the Accademia del Cimento. It originally consisted of 20 members, and continued to flourish long after the death of its founder. Two volumes (1676–85) of proceedings were published by Sturm. The former, *Collegium Experimentale sive Curiosum,* begins with an account of the diving-bell, "a new invention"; next follow chapters on the camera obscura, the Torricellian experiment, the air-pump, microscope, telescope, etc. It is now extinct.

The *Preussische Akademie der Wissenschaften* in Berlin holds the first place in Germany. Its origin was the *Societas Regia Scientiarum* constituted in 1700 by Frederick I. on the comprehensive plan of its first president, Leibnitz. It was reorganized under Frederick II. on the French model furnished by Maupertuis, and received its present constitution in 1812. It is divided into two classes and four sections—physical and mathematical, philosophical and historical. Among the contributors to its transactions (first volume published in 1710), to name only the dead, we find Immanuel Bekker, Böckling, Bernoulli, F. Bopp, P. Buttmann, Encke (of comet fame), L. Euler, the brothers Grimm, the two Humboldts, Lachmann, Lagrange, Leibnitz, T. Mommsen, J. Müller, G. Niebuhr, C. Ritter (the geographer), Savigny and Zumpt. To the *Berlin Academy* we owe the *Corpus Inscriptionum Graecarum,* the *Corpus Inscriptionum Latinarum,* and the *Monumenta Germaniae Historica.*

The *Bayerische Akademie der Wissenschaften,* at Munich, founded in 1759, is distinguished by the part it has played in national education. Maximilian Joseph, the enlightened elector (afterwards king) of Bavaria, induced the Government to hand over to it the organization and superintendence of public instruction, and this work was carried out by Privy-councillor Jacobi, the president of the academy. In recent years the academy has specially occupied itself with natural history.

The *Preussische Akademie gemeinnütziger Wissenschaften,* at Erfurt, which dates from 1754 and devotes itself to applied science, and the Hessian academy of sciences at Giessen, which publishes medical transactions, also deserve mention.

**Great Britain and Ireland.**—In 1616 a scheme for founding a royal academy was started by Edmund Bolton, an eminent scholar and antiquary, who in his petition to King James I. proposed that the title of the academy should be "King James, his Academe or College of honour." A list of the proposed original members is still extant, and includes the names of George Chapman, Michael Drayton, Ben Jonson, John Selden, Sir Kenelm Digby and Sir Henry Wotton. The death of King James put an

end to the undertaking. About 1645 the more ardent followers of Bacon used to meet, some in London, some at Oxford, for the discussion of subjects connected with experimental science. This was the original of the Royal Society (*q.v.*) which received its charter in 1662.

A society was formed in Dublin similar to the Royal Society in London, as early as 1683; but it was short-lived. The Royal Irish Academy grew from a society established in Dublin about 1782 by a number of gentlemen, most of whom belonged to the university The first volume of transactions appeared in 1788.

**Hungary.**—The *Magyar Tudományos Társasay* (Hungarian Academy of Sciences) was founded in 1825 by Count Stephen Széchenyi for the encouragement of the study of the Hungarian language and the various sciences. It has a fine building in Budapest containing a picture gallery and housing various national collections.

**Italy.**—The *Academia Secretorum Naturae* was founded at Naples in 1560 by Giambattista della Porta. The condition of membership was to have made some discovery in natural science. Della Porta was suspected of practising the black arts and summoned to Rome to justify himself before the papal court. He was acquitted on those charges by Paul V., but commanded to close his academy.

The *Academia dei Lincei* was founded in 1603 by Federigo Cesi, the marchese di Monticelli. Galileo and Colonna were among its earliest members. As a monument the Lincei have left the magnificent edition of Fernandez de Oviedo's *Natural History of Mexico* (Rome, 1651, fol ), printed at the expense of the founder and elaborately annotated by the members This academy was resuscitated in 1870 under the title of *Reale Accademia Nazionale dei Lincei,* with a literary as well as a scientific side, endowed in 1878 by King Humbert, and in 1883 it received official recognition from the Italian Government, being thereafter lodged in the Corsini palace, whose owner made over to it his valuable library and collections.

The *Accademia del Cimento* was founded at Florence in 1657 by Leopold de' Medici, brother of the grand duke Ferdinand II., at the instigation of Vincenzo Viviani, the geometrician. It was an academy of experiment, a deliberate protest against the deductive science of the quadrivium. It lasted only ten years, but the grand folio published in Italian (afterwards translated into Latin) in 1667 is a landmark in the history of science. It contains experiments on the pressure of the air (Torricelli and Borelli were among its members), on the incompressibility of water and on universal gravity.

Other pre-eminent Italian Academies are the new *Reale Accademia d'Italia,* and the *Reale Accademia delle Scienze di Torino.* The latter was founded in 1757 as a private society by a group of learned men (among whom was Joseph Louis la Grange), and incorporated by royal warrant in 1783. It consists of 60 *Soci Nazionali,* 20 *Soci Stranieri,* and 160 *Soci Corrispondenti.* It publishes volumes of *Memorie* and a yearly volume of proceedings, and awards prizes for learned works. There are, besides, royal academies of science at Naples, Lucca and Palermo.

**Portugal.**—The *Academia Real das Sciencias* (now *Acad. das Sciencias de Lisboa*) dates from 1779. It was reorganized in 1851 and since then has been chiefly occupied in the publication of *Portugaliae Monumenta Historica.*

**Russia.**—The *Académie Impériale des sciences de Saint-Petersbourg* (*Imperatorskaya Akademiya naük*), was established on Dec. 21, 1725, by Catherine I. Shortly afterwards the empress settled a fund of £4,982 per annum for the support of the academy; and 15 eminent members were admitted and pensioned, under the title of professors in the various branches of science and literature. The most distinguished of these were Nicholas and Daniel Bernouilli, the two Delisles, Bilfinger and Wolff. At the accession of Elizabeth the original plan was enlarged and improved; learned foreigners were drawn to St. Petersburg (Leningrad); and, what was considered a good omen for the literature of Russia, two natives, Lomonosov and Rumovsky, men of genius who had prosecuted their studies in foreign universities, were enrolled among its members. The annual income was increased to £10,659. Catherine II. utilized the academy for the advancement of national culture. By her recommendation the most intelligent professors visited all the provinces of her vast dominions, with most minute and ample instructions to investigate the natural resources, conditions and requirements, and report on the real state of the empire. The result was that no country at that time could boast, within so few years, such a number of excellent official publications on its internal state, its natural productions, its topography, geography and history, and on the manners, customs and languages of the different tribes that inhabited it, as came from the press of this academy. In its researches in Asiatic languages, oriental customs and religions, it proved itself the worthy rival of the Royal Asiatic Society in England. The first transactions, *Commentarii Academiae Scientiarum Imperialis Petropolitanae ad annum* 1726, with a dedication to Peter II., were published in 1728. In 1747 the transactions were called *Novi Commentarii Academiae,* etc.; and in 1777, *Acta Academiae Scientiarum Imperialis Petropolitanae.* The papers, hitherto in Latin only, were now written indifferently in Latin or in French. Of the *Commentaries,* 14 volumes were published; of the *New Commentaries* (1750–76) twenty. Of the *Acta Academiae* two volumes are printed every year. In 1872 there was published at St. Petersburg, in 2 vols., the valuable *Tableau général des matières contenues dans les publications de l'Académie Impériale des Sciences de St. Petersbourg* The academy of to-day has three divisions: (1) physical and mathematical sciences; (2) Russian language and literature; (3) historical science and philology A large number of laboratories and museums are affiliated to it, as well as a physico-mathematical and an Indo-European Institute. The Asiatic museum and the mineralogical museum are housed in this building, and also the academical botanical museum. The vast library of the Academy of Sciences is situated in a separate building, erected 1718–25. Its scientific publications are exempt from censorship and include transactions of its various sections, a monthly and a yearly journal. These are edited by the scientific staff of the academy, but published by the Soviet Government Publishing Department.

**Spain.**—The *Real Academia Española* at Madrid (*see* below) had a predecessor in the *Academia Naturae curiosorum* (dating from 1657) modelled on that of Naples. It was reconstituted in 1847 after the model of the French Academy.

**Sweden.**—The *Kongliga Svenska Vetenskaps-academien* owes its institution to six persons of distinguished learning, among whom was Linnaeus. In 1739 they formed a private society, the *Collegium Curiosorum.* In March 1741 it was incorporated as the Royal Swedish Academy. Though under royal patronage and largely endowed, it is, like the Royal Society in England, entirely self-governed. The dissertations read at each meeting are published in the Swedish language, quarterly, and make an annual volume. The first 40 volumes, octavo, completed in 1779, are called the *Old Transactions.*

Norway has an active Academy of Sciences at Oslo; Japan has an Imperial Academy at Tokyo; Yugoslavia has two academies, one Serbian at Belgrade and one Yugoslav at Zagreb. Czechoslovakia has the Czech Academy of Sciences and Arts at Prague.

## II. ACADEMIES OF BELLES LETTRES

**Belgium.**—Belgium has always been famous for its literary societies. The little town of Diest boasts that it possessed a society of poets in 1302, and the Catherinists of Alost date from 1107. It is at least certain that numerous chambers of rhetoric (so academies were then called) existed in the first years of the rule of the house of Burgundy.

**France.**—The French Academy (*l'Académie française*) was established by order of the king in the year 1635, but in its original form existed four or five years earlier. About the year 1629 certain literary friends in Paris agreed to meet informally each week. The conversation turned mostly on literary topics; and when one of the number had finished some literary work he read it to the rest, and they gave their opinions upon it. The fame of these meetings, though the members were bound to secrecy, reached the ears of Cardinal Richelieu, who promised his protec-

tion and offered to incorporate the society by letters patent. These were granted by the king on Jan. 29, 1635. The officers consisted of a director and a chancellor, chosen by lot, and a permanent secretary, chosen by vote. The director presided at the meetings, being considered as *primus inter pares*. The chancellor kept the seals and sealed all the official documents of the academy. The cardinal was *ex officio* protector.

The number of members was fixed at 40, but it was not till 1639 that the full number was completed. Their first undertaking consisted of essays written by the members in rotation. Next, at the instance of Cardinal Richelieu, they undertook a criticism of Corneille's *Cid*, the most popular work of the day. It was a rule of the academy that no work could be criticized except at the author's request, but fear of incurring the cardinal's displeasure wrung from Corneille an unwilling consent. The critique of the academy was re-written several times before it met with the cardinal's approbation. After six months of elaboration it was published under the title, *Sentiments de l'académie française sur le Cid*. This judgment did not satisfy Corneille, as a saying attributed to him on the occasion shows. "*Horatius*," he said, referring to his last play, "was condemned by the Duumviri, but he was absolved by the people." But the crowning labour of the academy, begun in 1639, was a dictionary of the French language. By the 26th article of their statutes they were pledged to compose a dictionary, a grammar, a treatise on rhetoric and one on poetry. Jean Chapelain, one of the original members, drew up a plan for compiling the dictionary, which was to a great extent carried out. C. F. de Vaugelas was appointed editor-in-chief. The first edition of this dictionary appeared in 1694, the sixth and last in 1835, since when *compléments* have been added.

**Reconstruction.**—The old *Académie* perished with other pre-revolutionary academies in 1793, and it has little but the name in common with the present academy, a section of the institute. The object of the Convention in 1795 was, as already stated, to rebuild all the institutions that the Revolution had shattered and to combine them in an organic whole. The institute was at first composed of 184 members resident in Paris and an equal number living in other parts of France, with 24 foreign members, divided into three classes: (1) physical and mathematical science, (2) moral and political science, (3) literature and the fine arts. It held its first sitting on April 4, 1796. Napoleon as first consul suppressed the second class, as subversive of government, and reconstituted the other classes as follows: (1) as before, (2) French language and literature, (3) ancient history and literature, (4) fine arts. The class of moral and political science was restored on the proposal of M. Guizot in 1832, and the present institute consists of the five classes named above. Each class or academy has its own special jurisdiction and work, with special funds; but there is a general fund and a common library, which, with other common affairs, are managed by a committee of the institute—two chosen from each academy, with the secretaries.

The class of the institute which deals with the language and literature takes precedence, and is known as the *Académie française*. There was at first no perpetual secretary, each secretary of sections presiding in turn. Shortly afterwards J. B. Suard was elected to the post, and ever since the history of the academy has been determined by the reigns of its successive perpetual secretaries. The secretary, to borrow an epigram of Sainte-Beuve, both reigns and governs. Among the best known in the 19th century were Suard, François Juste Raynouard, François Andrieux and Villemain. Under Raynouard the academy ran a tilt against the abbé Delille and his followers. Under Auger it did battle with romanticism, "a new literary schism." Auger did not live to see the election of Lamartine in 1829, and it needed ten more years for Victor Hugo after many vain assaults to enter by the breach. The academy is professedly non-political. It accepted and even welcomed in succession the empire, the restoration and the reign of Louis Philippe, and it tolerated the republic of 1848; but to the Second Empire it offered a passive resistance, and no politician of the Second Empire, whatever his gifts as an orator or a writer, obtained an armchair. The one seeming exception, Emile Ollivier, confirms the rule. He was elected on the eve of the Franco-German War, but his *discours de réception*, a eulogy of the emperor, was deferred and never delivered. The institute has large vested funds in property, including the magnificent estate and library of Chantilly bequeathed to it by the duc d'Aumale. It awards various prizes, of which the most considerable are the Montyon prizes, each of 20,000frs., one for the poor Frenchman who has performed the most virtuous action during the year, and one for the French author who has published the book calculated to prove of most service to morality.

A point of considerable interest is the degree in which, since its foundation, the French Academy has or has not represented the best literary life of France. It appears from an examination of the lists of members that a surprising number of authors of the highest excellence have, from one cause or another, escaped the honour of academic "immortality." When the academy was founded in 1634, the moment was not a very brilliant one in French letters. Among the 40 original members we find only ten who are remembered in literary history; of these four may reasonably be considered famous still—Balzac, Chapelain, Racan and Voiture. In that generation Scarron was never one of the 40, nor do the names of Descartes, Malebranche or Pascal occur. The one astounding omission of the 17th century, however, is the name of Molière, who was excluded by his profession as an actor; but the academy has made the *amende honorable* by placing in the *Salle des séances* a bust of Molière, with the inscription "*Rien ne manque à sa gloire, il manquait à la nôtre.*" On the other hand, the French Academy was never more thoroughly representative of letters than when Boileau, Corneille, La Fontaine, Racine and Quinault were all members. Of the great theologians of that and the subsequent age, the academy included Bossuet, Fléchier, Fénelon and Massillon, but not Bourdaloue. La Bruyère and Fontenelle were among the 40, but not Saint-Simon, whose claims as a man of letters were unknown to his contemporaries. Early in the 18th century almost every literary personage of eminence found his place naturally in the academy. The only exceptions of importance were Vauvenargues, who died too early for the honour, and two men of genius but of dubious social position, Le Sage and the abbé Prévost d'Exiles. The approach of the Revolution affected gravely the *personnel* of the academy. Montesquieu and Voltaire belonged to it, but not Rousseau or Beaumarchais. Of the Encyclopaedists, the French Academy opened its doors to D'Alembert, Condorcet, Volney, Marmontel and La Harpe, but not to Diderot, Rollin, Condillac, Helvétius or the Baron d'Holbach. Apparently the claims of Turgot and of Quesnay did not appear to the academy sufficient, since neither was elected. In the transitional period, when the social life of Paris was distracted and the French Academy provisionally closed, neither André Chénier nor Benjamin Constant nor Joseph de Maistre became a member. In the early years of the 19th century considerations of various kinds excluded from the ranks of the 40 the dissimilar names of Lamennais, Prud'hon, Comte and Béranger. Critics of the French Academy are fond of pointing out that neither Stendhal, nor Balzac, nor Théophile Gautier, nor Flaubert, nor Zola penetrated into the Mazarine palace. It is not so often remembered that writers so academic as Thierry and Michelet and Quinet suffered the same exclusion. In later times neither Alphonse Daudet nor the brothers de Goncourt, nor Guy de Maupassant were members. Verlaine, although a poet of genius, was of the kind that no academy can ever be expected to recognize.

Concerning the influence of the French Academy on the language and literature, the most opposite opinions have been advanced. Thus Matthew Arnold, in his *Essay on the Literary Influence of Academies*, has pronounced a glowing panegyric on the French Academy as a high court of letters, and a rallying-point for educated opinion, as asserting the authority of a master in matters of tone and taste. To it he attributes in a great measure that thoroughness, that openness of mind, that absence of vulgarity which he finds everywhere in French literature; and to the want of a similar institution in England he traces that eccentricity, that provincial spirit, that coarseness which, as he thinks, are barely compensated by English genius. Thus, too, Renan, one of its most distinguished members, says that owing to the academy "one

can say everything in the language of well-bred persons without being pedantic. Do not say they have done nothing, these obscure devotees of culture who spend their lives in investigating the credentials of words and weighing up syllables. They have produced a masterpiece—the French language." On the other hand, its inherent defects have been vigorously summed up by P. Lanfrey in his *Histoire de Napoléon.* The truth probably lies midway between the two extremes. Like all national institutions, the French Academy is a rather conservative body to which only people of a certain age and with well established reputations are elected. As a protest against such a state of things, the *Académie Goncourt* was founded by E. de Goncourt in 1896. It contains ten academicians whose principal function is to award an annual prize of 5,000 francs, preferably to a young novelist. None the less, since 1890, the *Académie française* may be said to have been fairly representative of the nation's culture. Among the critics may be cited, Brunetière Lemaître, Foguet; among the poets, Sully Prudhomme, Richepin, de Regnier, Valery; among the novelists, Bourget, Anatole France, Loti, Prevost; among the dramatists, Hervieu, Curel, Rostand, Brieux; among the historians, Masson, Vandal, Hanotaux, etc.; among the philosophers, Boutroux and Bergson. Of the writers best known abroad who have not been elected members of the academy are Maeterlinck, Romain Rolland, Proust and Gide.

**Germany.**—Of the German literary academies the most celebrated was *Die Fruchtbringende Gesellschaft* (the Fruitful Society), established at Weimar in 1617. Five princes were among the original members. The object was to purify the mother tongue. The German academies copied those of Italy in their quaint titles and petty ceremonials, and exercised little permanent influence on the language or literature of the country. Other noteworthy modern societies are the *Berlinsche Gesellschaft für Deutsche Sprache,* the *Deutsche Shakespeare Gesellschaft,* and the *Goethe Gesellschaft.*

**Italy.**—Italy in the 16th century was remarkable for the number of its literary academies. Tiraboschi, in his *History of Italian Literature,* has given a list of 171; and Jarkius, in his *Specimen Historiae Academiarum Conditarum,* enumerates nearly 700. Many of these, with a sort of Socratic irony, gave themselves ludicrous names, or names expressive of ignorance. Such were the *Lunatici* of Naples, the *Estravaganti,* the *Fulminales,* the *Trapessati,* the *Drowsy,* the *Sleepers,* the *Anxious,* the *Confused,* the *Unstable,* the *Fantastic,* the *Transformed,* the *Ethereal.* "The first academies of Italy chiefly directed their attention to classical literature. . . . It was not till the writings of Bembo furnished a new code of criticism in the Italian language that they began to study it with the same minuteness as modern Latin" (Hallam, *Int. to Lit. of Europe*). The Italian nobility, excluded as they mostly were from politics, and living in cities, found in literature a consolation and a career. Such academies were oligarchical in their constitution; they encouraged culture, but tended to hamper genius and extinguish originality. Far the most celebrated was the *Accademia della Crusca* or *Furfuratorum;* that is, of bran, or of the sifted, founded in 1582. The title was borrowed from a previous society at Perugia, the *Accademia degli Scossi,* of the well-shaken. Its device was a sieve; its principal object the purification of the language. Its great work was the *Vocabulario della Crusca,* printed at Venice in 1612. It was composed avowedly on Tuscan principles, and regarded the 14th century as the Augustan period of the language. Paul Beni assailed it in his *Anti-Crusca,* and this exclusive Tuscan purism has disappeared in subsequent editions. The *Accademia della Crusca* is now incorporated with two older societies—the *Accademia degli Apatici* (the Impartials) and the *Accademia Florentina.*

Among the numerous other literary academies of Italy we may mention the Academy of Naples, founded about 1440 by Alphonso, the king; the Academy of Florence, founded 1540, to illustrate and perfect the Tuscan tongue, especially by the close study of Petrarch; the *Intronati* of Siena, 1525; the *Infiammati* of Padua, 1534; the *Rozzi* of Siena, suppressed by Cosimo, 1568. In 1690 the *Accademia degli Arcadi* was founded at Rome, for the purpose of reviving the study of poetry, by Crescimbeni, the author of a history of Italian poetry. Its members came to its meetings masked and dressed like Arcadian shepherds. Within ten years from its establishment the number of academicians was 600. The Royal Academy of Savoy was founded in 1719, and made a royal academy by Charles Albert in 1848. Its emblem was a gold orange-tree full of flowers and fruit; its motto "Flores fructusque perennes," the same as that of the famous Florimentane Academy, founded at Annecy by St. Francis de Sales. It published valuable memoirs on the history and antiquities of Savoy. Mention should also be made of the *Società Dantesca Italiana.*

**Spain.**—The *Real Academia Española* at Madrid held its first meeting in July 1713, in the palace of its founder, the duke d'Escalona. In 1714 the king granted them the royal confirmation and protection. The number of its members was limited to 24; the duke d'Escalona was chosen director for life, but his successors were elected yearly, and the secretary for life. Their object, as marked out by the royal declaration, was to cultivate and improve the national language. They were to begin with choosing carefully such words and phrases as have been used by the best Spanish writers; noting the low, barbarous or obsolete ones; and composing a dictionary wherein these might be distinguished from the former. Another important Spanish Academy is the *Real Academia de la Historia* at Madrid.

### III. ACADEMIES OF ARCHAEOLOGY AND HISTORY

**France.**—The old *Académie des inscriptions et belles-lettres* (or *"Petite Académie,"* founded in 1663) was an offshoot of the French Academy, which then at least contained the *élite* of French learning. Louis XIV. was of all French kings the one most occupied with his own aggrandisement. Literature, and even science, he encouraged only so far as they redounded to his own glory. Thus it was that the Academy of Inscriptions arose. At the suggestion of Colbert a company (a committee we should now call it) had been appointed by the king, chosen from the French Academy, charged with the office of furnishing inscriptions, devices and legends for medals. It consisted of four academicians: Chapelain, then considered the poet laureate of France; the abbé Amable de Bourzeis (1606–71); François Charpentier (1620–1702), an antiquary of high repute, and the abbé Jacques de Cassagnes (1636–79). Their meetings were principally occupied with discussing the inscriptions, statues and pictures intended for the decoration of Versailles; and their first published work was a collection of engravings, accompanied by descriptions, designed for some of the tapestries at Versailles. Later Félibien, the learned architect, and the two great poets Racine and Boileau, were added to their number. A series of medals was commenced, entitled *Médailles de la Grande Histoire,* or, in other words, the history of *Le Grand Monarque.*

But it was to M. de Pontchartrain, comptroller-general of finance and secretary of State, that the academy owed its institution. By a new regulation, dated July 16, 1701, the *Académie royale des inscriptions et médailles* was instituted, being composed of ten honorary members, ten pensioners, ten associates, and ten pupils. In 1716 the regent changed its title to that of the *Académie des inscriptions et belles-lettres,* a title which better suited its new character.

In the great battle between the ancients and the moderns which divided the learned world in the first half of the 18th century, the Academy of Inscriptions naturally espoused the cause of the ancients, as the Academy of Sciences did that of the moderns. During the earlier years of the French Revolution the academy continued its labours uninterruptedly; and on Jan. 22, 1793, the day after the death of Louis XVI., we find in the *Proceedings* that M. Bréquigny read a paper on the projects of marriage between Queen Elizabeth and the dukes of Anjou and Alençon. On Aug. 2 of the same year the last séance of the old academy was held.

In the first draft of the new institute, Oct. 25, 1795, no class corresponded exactly to the old Academy of Inscriptions; but most of the members who survived found themselves re-elected either in the class of moral and political science, under which history and geography were included as sections, or more generally under the class of literature and fine arts, which embraced an-

cient languages, antiquities and monuments. In 1816 the academy received again its old name. Perhaps the subjects on which it has shown most originality are comparative mythology, the history of science among the ancients, and the geography and antiquities of France. The old academy has reckoned among its members De Sacy the orientalist, Dansse de Villoison (1750–1805) the philologist, Anquetil du Perron the traveller, Guillaume J. de C. L. Sainte-Croix and du Theil the antiquaries, and Le Beau, who has been named the last of the Romans. The new academy included the names of Champollion, A. Rémusat, Raynouard, Burnouf and Augustin Thierry.

In consequence of the attention of several literary men in Paris having been directed to Celtic antiquities, a *Celtic Academy* was established in that city in 1805. It still exists as *La société nationale des antiquaires de France.*

**Great Britain.**—The British Academy was the outcome of a meeting of the principal European and American academies, held at Wiesbaden in Oct. 1899. A scheme was drawn up for an international association of the academies of the world under the two sections of natural science and literary science, but while the Royal Society adequately represented England in science there was then no existing institution that could claim to represent England in literature. A separate society was therefore formed entitled "The British Academy for the promotion of historical, philosophical and philological studies," which on Aug. 8, 1902, was incorporated by royal charter. The objects of the academy are therein defined: "the promotion of the study of the moral and political sciences, including history, philosophy, law, politics and economics, archaeology and philology." The number of fellows (so all members are entitled) is restricted to 150 and the academy is governed by a president and a council of 15 elected annually by the fellows.

The published *Proceedings of the British Academy* amount already to 12 volumes. Other publications are *Sp[illegible] Papers* (1911, etc.) and the annual *Schweich Lectur[illegible]* archaeology, inaugurated in 1908. *The Fund* has also enabled the academy to forward the work of excavation in Bible lands. The series of *Social and Economic Records* under the direction of Sir Paul Vinogradoff was started in 1908. with the support of a Government grant. The publication, by the Clarendon Press, of the facsimile *Old Testament of the Codex Sinaiticus* (1911–22) was made possible by an anonymous gift. The academy has also published a facsimile of the Caedman ms.

In 1908 the academy organized the commemoration of the tercentenary of Milton's birth. It is helped by the foundation of the annual Master Mind lecture (one of a number of endowments, under the will of the late Henriette Hertz). In 1927 it celebrated its 25th anniversary, the hon. secretary, Sir Israel Gollancz, having held uninterrupted office since the beginning. Among other endowments may be mentioned the annual Shakespeare lecture, the annual Raleigh lectures on history, the Warton lecture on English poetry; the Philosophical lecture; the Italian lecture; the lecture on aspects of art; the lecture on English philology and literary history; the Cromer prize for Greek essay; the biennial prize for English studies. The academy administers also the Rose Mary Crawshay prize fund for English literature, an annual prize of £100 awarded to a woman of any nationality for work on English literature.

The school of oriental studies, now an integral part of the University of London, was largely the outcome of a scheme submitted to the academy in 1904 by the late Prof. Rhys Davids. The organization of imperial studies, now recognized in London and in other British universities, was directly due to proposals made by Sir Sidney Low to the academy in 1912. The English Place-Name Society, founded in 1921 to carry out the survey of English place-names, was inaugurated under the auspices of the British academy in 1923, as the result of a statement submitted by Prof. A. Mawer, now director of the society. The foundation of the British School of Archaeology in Jerusalem in 1919 was brought about by the academy, in conjunction with the Palestine exploration fund. The establishment of the British school at Jerusalem must take an important place among the more recent efforts of the academy. Among its recent excavations are those on the Hill of Ophel at Jerusalem, the results of which confirm the view as to the site of the city of David. Meanwhile remarkable discoveries have been made in the Near East. Among the enterprises promoted by the academy is the *Encyclopaedia of Islam* (1908, etc.).

The academy is closely associated with the newly established Union Academique Internationale. The principal proposals of the Union in which the academy is concerned are the following: (a) *Corpus vasorum* (1922, etc); (b) *Catalogue of Alchemical mss.* (1926, etc.); (c) *Dictionary of Mediaeval Latin;* (d) *Forma Orbis Romani;* and (e) supplements to the *Corpora Inscriptionum graecarum et latinarum.*

**Italy.**—The *Accademia Ercolanese* (*Academy of Herculaneum*) was established at Naples about 1755, at which period a museum was formed of the antiquities found at Herculaneum, Pompeii and other places, by the marquis Tanucci. Its object was to explain the paintings, etc., discovered at those places, and for this purpose the members met every fortnight. The first volume of their labours appeared in 1775, and they have been continued under the title of *Antichità di Ercolano.* They contain engravings of the principal paintings, statues, bronzes, marble figures, medals, utensils, etc., with explanations. In the year 1807 an academy of history and antiquities, on a new plan, was established at Naples by Joseph Bonaparte, but the subsequent changes in the political state of Naples prevented the full and permanent establishment of this institution. In the same year an academy was established at Florence for the illustration of Tuscan antiquities, which published some volumes of memoirs.

## IV. ACADEMIES OF MEDICINE AND SURGERY

**Austria.**—The Academy of Surgery at Vienna was instituted in 1784 by the emperor Joseph II. under the direction of the distinguished surgeon, Giovanni Alessandro Brambilla (1728–1800). In 1874 it ceased to exist; its functions had become mainly military and were transferred to newer schools.

**France.**—Charlemagne is said to have established a school of medicine in the Louvre, and various societies have been founded and privileges granted to the faculty by his successors. The *Académie de médecine* succeeded to the old *Académie royale de chirurgie et société royale de médecine* in 1820. The new academy was divided into three sections—medicine, surgery and pharmacy. In its constitution it closely resembled the *Académie des sciences.*

**Germany.**—The *Academia Naturae Curiosi,* afterwards called the *Academia Caesaraea Leopoldina,* was founded in 1662 by J. L. Bausch, a physician of Leipzig. The works of the *Naturae Curiosi* were at first published separately; but from 1784 this appeared annually under the title of *Ephemerides.* In 1687 the emperor Leopold took the society under his protection, and its name was changed in his honour. This academy has no fixed abode, but follows the home of its president. Its library remains at Dresden.

## V. ACADEMIES OF THE FINE ARTS

**France.**—The *Académie royale de peinture et de sculpture* at Paris was founded by Louis XIV. in 1648, under the title of *Académie royale des beaux arts,* to which was afterwards united the *Académie d'architecture,* founded 1671. It is composed of painters, sculptors, architects, engravers and musical composers. From among the members of the society who are painters, is chosen the director of the French *Académie des beaux arts* at Rome, also instituted by Louis XIV. in 1677. The director's province is to superintend the studies of the painters, sculptors, etc., who, chosen by competition, are sent to Italy at the expense of the Government, to complete their studies in that country. The *Académie nationale de musique* (*q.v.*) is the official and administrative name given in France to the grand opera.

**Great Britain.**—The Royal Academy of Arts in London, founded in 1768, is described in a separate article. (*See* ACADEMY, ROYAL.)

The *Academy of Ancient Music* was established in London in 1710, with the view of promoting the study and practice of vocal and instrumental harmony. About 1734 the academy became a

seminary for the instruction of youth in the principles of music and the laws of harmony. The *Royal Academy of Music* was formed for the performance of operas, composed by Handel and conducted by him at the theatre in the Haymarket. A contest between Handel and Senesino, one of the performers, in which the directors took the part of the latter, occasioned the dissolution of the academy after it had existed with honour for more than nine years. The present *Royal Academy of Music* dates from 1822, and was incorporated in 1830. It instructs pupils of both sexes in music. (*See* also the article CONSERVATOIRE for colleges of music.)

The *Royal Academy of Dramatic Art* (incorporated in 1920), was originally founded by Beerbohm Tree in 1904. It provides a thorough training for the stage. Like the Royal Academy and the Royal College of Music it receives a grant of £500 a year from the Government. It awards annually certain scholarships, and also prepares for the diploma in dramatic art of London university. A somewhat similar institution is the School of Speech Training and Dramatic Art (incorporated), founded by Miss E. Fogerty, which also prepares for the stage.

**Italy.**—In 1778 an academy of painting and sculpture was established at Turin. In Milan an academy of architecture was established so early as 1380, by Gian Galeazzo Visconti. About the middle of the 18th century an academy of the arts was established there, after the example of those at Paris and Rome. Before the effects of the French Revolution reached Italy this was one of the best establishments of the kind in that kingdom. The academy of the arts, which had been long established at Florence, fell into decay, but was restored at the end of the 18th century. But the treasures of this and the other institutions for the fine arts were greatly diminished during the occupation of Italy by the French. There are also academies of the fine arts in Mantua, Venice and Naples.

**Russia.**—The academy of St. Petersburg was established in 1757 by the empress Elizabeth, at the suggestion of Count Shuvalov, and annexed to the academy of sciences. It is now known as the *Akademiya Nauk Soyuza Sovetskich Sociallisticheskich Respublik.*

**South America.**—There are several small academies in the various towns of South America, the most important being that of Rio de Janeiro, founded by John VI. of Portugal in 1816 and now known as the *Escola Nacional de Bellas Artes.*

**Spain.**—In Madrid an academy for painting, sculpture and architecture, the *Academia de Bellas Artes de San Fernando,* was founded by Philip V. The minister for foreign affairs is president. Prizes are distributed every three years. In Cadiz a few students are supplied by the Government with the means of drawing and modelling from figures; and such as are not able to purchase the requisite instruments are provided with them.

**Sweden.**—An academy of fine arts was founded at Stockholm in the year 1733 by Count Tessin. Such students as display distinguished ability obtain pensions from the Government, to enable them to reside in Italy for some years for the purposes of investigation and improvement. In this academy there are nine professors and generally about 400 students.

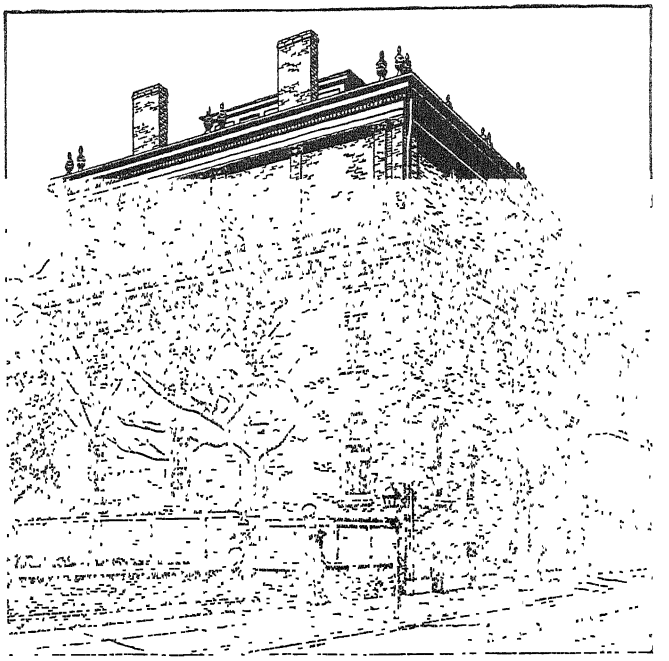
**Austria.**—In the year 1705 an academy of painting, sculpture and architecture was established at Vienna, with the view of encouraging and promoting the fine arts.

*See* also SOCIETIES, LEARNED.

The volume of excerpts from the general catalogue of books in the British Museum, "Academies," five parts and index, furnishes a complete bibliography. *See* also *Minerva* published in Berlin and Leipzig and *Index Generalis* published in Paris. (C. BR.)

**United States.**—The early organization of scholars in America took a form frankly imitative of that prevalent in Europe. Academies were organized in Philadelphia and Boston in the 18th century, which, like their European prototypes, were divided into different classes. Election to membership in them was in recognition of scholarly or scientific attainment, and they still closely resemble their European counterparts

American scientists and scholars, however, have found their most effective organization in societies and associations of open membership, described in the article on Learned Societies. These frequently maintain a national headquarters at either Washington, D.C., or New York city, co-ordinate the work of the affiliated societies throughout the United States and even Canada and often issue an annual or quarterly publication, sometimes in addition to a more popular monthly magazine. There are, for example, the Archaeological Institute of America, organized in 1879, and the American Federation of Arts, which was organized in 1909 to further art in the United States by means of lectures, exhibitions and publications. There are, too, many so-called academies, clubs, societies, guilds, leagues and associations devoted to the



BY COURTESY OF AMERICAN PHILOSOPHICAL SOCIETY

ORIGINAL BUILDING AT PHILADELPHIA OF THE AMERICAN PHILOSOPHICAL SOCIETY FOR THE PROMOTION OF USEFUL KNOWLEDGE FOUNDED IN 1727 BY BENJAMIN FRANKLIN

preservation, study and furtherance of the fine arts, the physical and natural sciences, natural scenery and historic landmarks and to the improvement of cities (see *American Art Annual,* v. XXIV., 1927). Finally, there are various Federal, State and municipal art commissions that generally supervise the embellishment of public works.

Of the American organizations the following most nearly approximate the European *academy* as it has been considered here: The American Academy of Arts and Letters was organized in 1904 from within the membership of the National Institute of Arts and Letters. Founded in 1898 by members of the American Social Science Association, the National Institute of Arts and Letters now has a membership limited to 250 and divided into three sections: literature, art and music. To be elected to the Institute a candidate must be proposed by a member of his own group and receive a vote of the majority of his section and later a majority vote of those present at the annual meeting. Its executive office is in the Academy building at 633 West 155th street, New York city. The American Academy of Arts and Letters operates under a Federal charter. It is limited to 50 members, chosen from the membership of the Institute only. Unlike the Institute, it functions as a whole and a literary man is not necessarily elected to fill the chair formerly occupied by a literary man. Apart from the honour conferred by membership, the actual work of the Academy is to promote American literature and art by giving the stamp of its approval of the best that both the past and the present have to offer, by means of public addresses, by bringing to the United States representatives of other Academies and, through conferences and discussion, thereby helping to establish a literary and artistic entente between nations, and through its exhibitions, publications, collections and awards.

The American Academy of Arts and Sciences, Boston, the second oldest scientific society in the United States, was chartered in 1780 by a group of distinguished citizens of Massachusetts, including John and Samuel Adams and John Hancock. The membership is divided into three classes, covering the physical and mathematical, the natural and physiological, and the moral and political sciences. It includes fellows (limited to 600), associates and foreign honorary members, elected on the basis of recognition of scholarship or professional eminence. The academy publishes *Proceedings* and *Memoirs*. It administers various trust funds in aid of physical and chemical research, and awards the Rumford medal to the authors of "any important discovery or useful improvement in light or heat which shall have been made in any part of America." It has a commodious building but no considerable endowment. The library is rich in the fields of physics, chemistry, mathematics and in the publications of learned societies of other countries.

The American Philosophical Society Held at Philadelphia for Promoting Useful Knowledge is the oldest scientific association in the United States. The society is the outgrowth of the Junto founded by Franklin in 1727. In 1743 Franklin published *A Proposal for Promoting Useful Knowledge among the British Plantations in America*, which was so favourably received that in the same year the society was organized, with Thomas Hopkinson (1709–51) as president and Franklin as secretary. In 1769 it united with another scientific society founded by Franklin, called the American Society Held at Philadelphia for Promoting Useful Knowledge, and adopted its present name, adding the descriptive phrase from the title of the American Society, and elected Franklin president, an office which he held until his death (1790) The American Philosophical Society is national in scope and comprehends all departments of learning; its *Transactions* date from 1771, and its *Proceedings* from 1838. It has a hall in Philadelphia with meeting-rooms and a valuable library and collection of interesting portraits and relics. David Rittenhouse was its second and Thomas Jefferson its third president. In 1786 John Hyacinth de Magellan, of London, presented a fund, the income of which was to supply a gold medal for the author of the most important discovery "relating to navigation, astronomy or natural philosophy (mere natural history excepted)."

The National Academy of Sciences (1863) was incorporated by Congress with the object that it "shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art." Its membership was first limited to 50; after the amendment of the act of incorporation in 1870 the limit was placed at 100; and in 1907 it was prescribed that the resident membership should not exceed 150 in number, no more than ten members to be elected in any one year, and that the number of foreign associated be restricted to 50. The constitution was later amended to provide that the membership shall not exceed 250 and that not more than 15 members shall be elected at one annual meeting. The academy is divided into ten sections: mathematics, astronomy, engineering, chemistry, geology and palaeontology, botany, zoology and anatomy, physiology and pathology, anthropology and psychology. It gives several gold medals for meritorious researches and discoveries, and holds also a number of small trust funds, from the income of which grants are made for scientific research. It publishes scientific and biographical memoirs, an annual report and monthly proceedings.

The National Academy of Design was founded in 1826 and incorporated in 1828. The first president was Samuel Finley Breese Morse, a portrait painter who subsequently invented the telegraph. The number of "associates" is unlimited but the number of "academicians" is limited to 125 painters, 25 sculptors and 25 architects or engravers. Two exhibitions are given annually and each member is entitled to exhibit one work without approval by the jury of selection.

The American Institute of Architects was chartered in 1857 with Richard Upjohn as president and Richard M. Hunt as secretary. It merged with the Western Association of Architects (founded 1884) in 1889 and has since been national in scope. Since 1902 admission to membership has required an accredited diploma, or scholarship, or passing an examination either technical or on the candidate's work and standing An annual convention is held and an annuary and monthly journal are issued.

ACADEMY, GREEK, or ACADEMIC, the name given to the philosophic school founded by Plato. The name is derived from a pleasure garden or gymnasium situated in the suburb of the Ceramicus on the river Cephissus about a mile to the north-west of Athens from the gate called Dipylum. It was said to have belonged to the ancient Attic hero Academus, who, when the Dioscuri invaded Attica to recover their sister Helen, carried off by Theseus, revealed the place where she was hidden. Out of gratitude the Lacedaemonians, who reverenced the Dioscuri, always spared the Academy during their invasions of the country. It was walled in by Hipparchus and was adorned with walks, groves, and fountains by Cimon (Plut. *Cim.* 13), who bequeathed it as a public pleasure ground to his fellow citizens. Subsequently the garden became the resort of Plato (*q.v.*) who had a small estate in the neighbourhood Here he taught for nearly 50 years till his death in 348 B C, and his followers continued to make it their headquarters. It was closed for teaching by Justinian in A D. 529 along with the other pagan schools. Cicero borrowed the name for his villa near Puteoli, where he composed his dialogue, *The Academic Questions*.

The Platonic Academy (proper) lasted from the days of Plato to those of Cicero, and during its whole course there is traceable a distinct continuity of thought which justifies its examination as a real intellectual unit. On the other hand, this continuity of thought is by no means an identity. The Platonic doctrine was so far modified in the hands of successive scholarchs that the Academy has been divided into either two, three or five main sections (Sext. Empir. *Pyrrh. Hyp.* i. 220). Finally, in the days of Philo, Antiochus and Cicero, the metaphysical dogmatism of Plato had been changed into an ethical syncretism which combined elements from the Scepticism of Carneades and the doctrines of the Stoics; it was a change from a dogmatism which men found impossible to defend, to a probabilism which afforded a retreat from Scepticism and intellectual anarchy. Cicero represents at once the doctrine of the later Academy and the general attitude of Roman society when he says, "My words do not proclaim the truth, like a Pythian priestess; but I conjecture what is probable, like a plain man; and where, I ask, am I to search for anything more than verisimilitude?" And again: "The characteristic of the Academy is never to interpose one's judgment, to approve what seems most probable, to compare together different opinions, to see what may be advanced on either side and to leave one's listeners free to judge without pretending to dogmatize."

The passage from Sextus Empiricus, cited above, gives the general view that there were three academies: the first, or Old, academy under Speusippus and Xenocrates; the second, or Middle, academy under Arcesilaus and Polemon; the third, or New, academy under Carneades and Clitomachus. Sextus notices also the theory that there was a fourth, that of Philo of Larissa and Charmidas, and a fifth, that of Antiochus. Diogenes Laertius says that Lacydes was the founder of the New Academy (i. 19, iv. 59). Cicero (*de Orat.* iii. 18, etc.) and Varro insist that there were only two academies, the Old and the New. Those who maintain that there is no justification for the five-fold division hold that the agnosticism of Carneades was really latent in Plato, and became prominent owing to the necessity of refuting the Stoic *criterion*.

The general tendency of the Academic thinkers was towards practical simplicity, a tendency due in large measure to the inferior intellectual capacity of Plato's immediate successors. Cicero (*de Fin.* v. 3) says generally of the Old Academy: "Their writings and method contain all liberal learning, all history, all polite discourse; and besides they embrace such a variety of arts that no one can undertake any noble career without their aid . . . In a word the Academy is, as it were, the workshop of every artist." It is true that these men turned to scientific investigation, but in so doing they escaped from high altitudes in which Plato thought, and tended to lay emphasis on the mundane side of philosophy.

Of Plato's originality and speculative power, of his poetry and enthusiasm they inherited nothing, "nor amid all the learning which has been profusely lavished upon investigating their tenets is there a single deduction calculated to elucidate distinctly the character of their progress or regression" (Archer Butler, *Lect. on Anc. Phil* ii, 315)

The modification of Academic doctrine from Plato to Cicero may be indicated briefly under four heads.

(1) Plato's own theory of Ideas was not accepted even by Speusippus and Xenocrates. They argued that the Good cannot be the origin of things, inasmuch as Goodness is only found as an attribute of things. Therefore, the idea of Good must be secondary to some other more fundamental principle of existence. This unit Speusippus attempted to find in the Pythagorean number theory. From it he deduced three principles, one for numbers, one for magnitude, one for the soul. The Deity he conceived as that living force which rules all and resides everywhere. Xenocrates, though like Speusippus infected with Pythagoreanism, was the most faithful of Plato's successors. He distinguished three spheres, the sensible, the intelligible, and a third compounded of the two, to which correspond respectively, sense, intellect and opinion ( δόξα ). Cicero notes, however, that both Speusippus and Xenocrates abandon the Socratic principle of hesitancy.

(2) Up to Arcesilaus, the Academy accepted the principle of finding a general unity in all things, by the aid of which a principle of certainty might be found. Arcesilaus, however, broke new ground by attacking the very possibility of certainty. Socrates had said, "This alone I know, that I know nothing." But Arcesilaus went farther and denied the possibility of even the Socratic minimum of certainty: "I cannot know even whether I know or not." Thus from the dogmatism of the master the Academy plunged into the extremes of agnostic criticism.

(3) The next stage in the Academic succession was the moderate scepticism of Carneades, which owed its existence to his opposition to Chrysippus, the Stoic. To the Stoical theory of *apprehensible* (or *knowable*) *presentation,* by which they expressed a conviction of certainty arising from impressions so strong as to amount to real knowledge, he opposed the doctrine of *inapprehensible* (or *unknowable*) *presentation,* which denied any necessary correspondence between perceptions and the objects perceived. He saved himself, however, from absolute scepticism by the doctrine of probability or verisimilitude, which may serve as a practical guide in life. Thus his criterion of imagination is that it must be credible, irrefutable, and attested by comparison with other impressions; it may be wrong, but for the person concerned it is valid. In ethics he was an avowed sceptic. During his official visit to Rome he gave public lectures, in which he successively proved and disproved with equal ease the existence of justice.

(4) In the last period we find a tendency not only to reconcile the internal divergences of the Academy itself, but also to connect it with parallel growths of thought. Philo of Larissa endeavours to show that Carneades was not opposed to Plato, and further that the apparent antagonism between Plato and Zeno was due to the fact that they were arguing from different points of view. From this syncretism emerged the prudent noncommittal eclecticism of Cicero, the last product of Academic development.

For detailed accounts of the Academicians *see* ARISTOTLE, XENOCRATES, OF CHALCEDON, etc., also STOICS and NEOPLATONISM. Histories of philosophy by Erdmann, Zeller, and Windelband, and Th. Gomperz, *Greek Thinkers,* ii, 270 (Eng. trans., 1905).

**ACADEMY, ROYAL.** The Royal Academy of Arts in London, to give it the original title in full, was founded in 1768, "for the purpose of cultivating and improving the arts of painting, sculpture and architecture." It was the outcome of many attempts which had previously been made in England to form a society which should have for its object the advancement of the fine arts. No time was lost in establishing the schools, and on Jan. 2, 1768, they were opened at some rooms in Pall Mall, a little eastward of the site now occupied by the Junior United Service club, the president, Sir Joshua Reynolds, delivering on that occasion the first of his famous "Discourses." The opening of the first exhibition at the same place followed on April 26.

The government of the academy was by the "Instrument" vested in "a president and eight other persons, who shall form a council." Four of these were to retire every year, and the seats were to go by rotation to every academician. The number was increased in 1870 to 12, and reduced to ten in 1875. The rules as to retirement and rotation are still in force Newly elected academicians begin their two years' service as soon as they have received their diploma. The council has, to quote the "Instrument," "the entire direction and management of the business" of the academy in all its branches, and also the framing of new laws and regulations; but the latter, before coming into force, must be sanctioned by the general assembly of academicians and approved by the sovereign. The original number of academicians was fixed in the "Instrument" at 40, and has so remained. Each academician on his election has to present an approved specimen of his work—called his diploma work—before his diploma is submitted to the sovereign for signature. On receiving his diploma he signs the Roll of Institution as an academician, and takes his seat in the general assembly. The class of associates, out of whom alone the academicians can be elected, was founded in 1769.

One of the most important functions of the Royal academy, and one which for nearly a century it discharged alone was the instruction of students in art. The first act, as has been shown, of the newly founded academy was to establish schools—"an Antique Academy," and a "School for the Living Model" for painters, sculptors and architects. A school of painting was added in 1815, and special schools of sculpture and architecture in 1871. The schools consist of an antique school, a school of painting, a school of drawing from the life, a school of modelling from the life and an architectural school. Admission is gained by submitting specimens of drawing or modelling, and the successful candidates, called probationers, have then to undergo a further test in the schools, on passing which they are admitted as students for five years. Female students were first admitted in 1860. There are permanent curators and teachers in all the schools, but the principal teaching is done by the keeper and visitors—academicians and associates—elected to serve in each school.

Another of the principal objects to which the profits of the Royal academy have been devoted has been the relief of distressed artists and their families. The source from which have been derived the funds for carrying on the varied work of the Royal academy, its schools, its charities and general cost of administration, and which has enabled it to spend large sums on building, and provided it with the means of maintaining the buildings, has been the annual exhibitions. There is an annual winter exhibition of works by old masters and deceased British artists, and a summer exhibition of works by living artists.

**Presidents of the Royal Academy.**—Sir Joshua Reynolds, 1768–92; Benjamin West (resigned), 1792–1805; James Wyatt, 1805; Benjamin West (re-elected), 1806–20; Sir Thomas Lawrence, 1820–30; Sir Martin Archer Shee, 1830–50; Sir Charles Lock Eastlake, 1850–65; Sir Francis Grant, 1866–78; Frederic, Lord Leighton of Stretton, 1878–96; Sir John Everett Millais, 1896; Sir Edward John Poynter, Bt., 1896–1918; Sir Aston Webb, 1919–24; Sir Frank Dicksee, 1924–28; Sir W. Llewellyn, 1928–38; Sir E. Lutyens, 1938–44; Sir Alfred Munnings, 1944– .

The library of about 11,000 volumes, some of them of great rarity and value, is open daily to the students and members, and to others on introduction. The trust funds administered by the Royal academy include the following: The Turner fund, the Creswick fund, the Landseer fund, the Armitage fund, the Leighton bequest and the Edward Stott fund.

BIBLIOGRAPHY.—The literature concerning the Royal academy consists chiefly of pamphlets and articles of more or less ephemeral value. More serious works are: William Sandby, *The History of the Royal Academy of Arts* (1862) (withdrawn from circulation on a question of copyright); *Report from the Select Committee on Arts and their Connection with Manufactures, with the Minutes of Evidence and Appendix* (1836); *Report of the Royal Commission on the Royal Academy, with Minutes of Evidence and Appendix* (1863); Martin Archer Shee, *The Life of Sir M. A. Shee, P.R.A.* (1860); C. R. Leslie, R.A., and Tom Taylor, *Life and Times of Sir Joshua Reynolds, P.R.A.* (1865); J. E. Hodgson, R.A., and F. A. Eaton, Sec. R.A. *The Royal Academy and its Members, 1768–1830* (1905). But the chief sources

of information on the subject are the minute-books of the council and of the general assembly, and the annual reports, which, however, only date from 1859. (F. A. E.; W. R. M. L.)

**ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, THE,** founded in 1812, possesses a library of 120,000 volumes and 7,000,000 natural history specimens. Its free museum contains 19 habitat groups of animals, as well as a Hall of Earth History and exhibits of birds, minerals and insects. The academy's scientific staff is comprised of 48 research scientists. It has published the *Proceedings* continuously since 1841, in addition to *The Manual of Conchology* and *Frontiers*. From 1929 to 1939, 200 expeditions sought new specimens in all parts of the world for its collections. Since 1876 The American Entomological society has been affiliated with it.

**ACADIA** or **ACADIE,** a district in what is now Nova Scotia and eastern New Brunswick, so named either because Verrazano called a part of the coast *Arcadia* in 1524, or from the Micmac *acadie*, fertile land, found in several place names. Visited by Champlain in 1603 and by De Monts in 1604, and colonized by France, Acadia was a bone of contention in the wars between France and England. It became English under the treaty of Utrecht in 1713. In 1755 the imminence of war with France, the vexed question of the neutrality of the Acadians and their possible revolt, led to the forcible deportation of the majority of the Nova Scotia Acadians (about 6,500). Their settlements were destroyed and those not deported driven into the wilderness. This deportation is the theme of Longfellow's *Evangeline*. The Acadians were distributed among the English colonies. One party made its way to Bayou Teche, Louisiana, where Cable has described their modern life. After the peace of 1763, about 800 returned to New Brunswick, where the name Acadien is still current. *See* G. P. Bible, *An Historical sketch of the Acadians* (1892); A. Doughty, *The Canadian Exiles* (1914).

**ACAJUTLA,** a Pacific port of El Salvador, Central America, terminus of the British-owned Salvador railroad, and coffee-shipping centre for the republic. The population is (1940) 1,448, and the port an open roadstead, passengers and freight being handled by lighters. The town is 65 mi. distant from San Salvador and 12 mi. from Sonsonate.

**ACANTHACEAE,** a large family of dicotyledonous plants, chiefly tropical and subtropical with bilabiate irregular flowers and for the most part with dehiscent capsules, the seeds borne on characteristic more or less elastic jaculatoria or retinacula, an aid in seed dispersal. In this family, considerable use of pollen grain characters has been made in differentiating genera. The species, all herbs, shrubs or vines, in excess of 2,500, are arranged in about 180 genera. Some of these genera are very large, such as *Justicia,* with in excess of 250 species. Many species are cultivated for ornamental purposes, especially in such genera as *Thunbergia, Graptophyllum, Aphelandra, Barleria, Ruellia, Justicia, Jacobinia, Beloperone, Strobilanthes, Eranthemum, Phlogacanthus,* and others. The leaf characters of certain species of *Acanthus* (*q.v.*) form an important part of the design on the capitals of classical Grecian and Roman columns.

**ACANTHOCEPHALA.** These thorny-headed worms are obligatory parasites, perfectly adapted to parasitic existence, since no stage in the life history possesses any specialized organs for digestion. The mature worms, invariably of separate sexes, live in the intestines of vertebrate hosts, where food is obtained exclusively by absorption through the body wall. While in some species fully mature females are less than 2 mm. (.08 in.) long, in other species they have been reported to exceed 500 mm. (20 in.). Males are usually smaller than females of the same species.

All groups of vertebrates may serve as hosts for Acanthocephala, although for each vertebrate class there are some distinctive genera and species. Introduction into the host intestine is always along with food. So far as known, an arthropod is invariably the first host, although animals which feed upon arthropods may serve as intermediate hosts to carry the worms to the vertebrate.

A typical life cycle is that of *Macracanthorhynchus hirudinaceus* (Pallas, 1781), a species which dwells in the intestine of the hog and undergoes larval development in soil-inhabiting beetle larvae. Developing eggs are given off by the female worm and reach the ground with the intestinal wastes of the pig. In the soil they may be eaten by grubs of the June beetle, cockchafer or other beetle larvae. Within the digestive tract of the grub the egg hatches to a stage called an acanthor. By growth and metamorphosis the acanthella or infective larval stage is reached while still within the body of the grub. The parasite never reaches maturity unless its sheltering beetle larva is devoured by a pig or other suitable host in whose intestine the life cycle is completed.

One of the most distinctive features of all Acanthocephala is the hook-covered proboscis which may be of extremely diverse size and shape. By the use of special muscles this organ is capable of being inverted and withdrawn into a muscular proboscis receptacle within the front end of the body. If in contact with the host intestine when everted, the proboscis hooks tear their way into the intestinal wall to anchor the worm securely.

The wall of the body-proper is composed mainly of a syncytial subcuticula permeated by a series of fluid-filled canals termed the lacunar system. Two continuations of this tissue into the body cavity at its front end constitute organs of problematical function known as the lemnisci. The external surface of the entire body is covered by a cuticula which in many species is adorned with spines.

On its inner surface the subcuticula is lined by two layers of muscle fibres, of which those next to the body cavity are directed longitudinally, the others circularly

A greatly reduced central nervous system or brain is located within the proboscis receptacle, from which a few small nerve fibres pass to surrounding structures. There are no highly specialized sense organs.

Genital organs in both sexes are held in place within a ligament which runs lengthwise through the body cavity. The ovary very early breaks up into a large number of floating egg masses; hence each female is incapable of producing more than one quota of eggs.

Upon fertilization each egg becomes surrounded by a series of protecting membranes and breaks away from the egg mass. Ultimately the developing eggs fill the entire body cavity. The female pore, at or near the posterior extremity, is guarded by a circular muscle, the vaginal sphincter. A short vagina receives the tubular or sac-shaped uterus, which at its forward end bears the uterine bell and the selective apparatus. The funnel-shaped uterine bell opens into the body cavity, which is divided by partitions into a dorsal and a ventral ligament-sac.

When fully mature eggs are passed through the uterine bell into the selective apparatus, they are passed on into the uterus and finally out through the vagina. Eggs not yet ready for elimination are returned to the body cavity by the selective apparatus.

Male organs consist of a pair of testes followed posteriorly by one or a series of cement glands. Accessory male structures include ducts and storage reservoirs for sperm and cement and a complicated eversible bursa, or pouch, for copulation, surrounding the cirrus.

In most species excretory wastes are eliminated through the body surface, although in some of the large forms a pair of branched protonephridial organs are associated with the reproductive organs.

Acanthocephala have been considered by many zoologists as a subdivision of the roundworms. However, in general plan as well as in detail of structure, in their development and in their relationships within the host, they closely parallel the cestodes. Their many distinctive features are best acknowledged by considering them as an independent phylum.

A. Meyer (1932–33) recognized 58 genera with somewhat more than 300 species. Approximately 100 additional species and 20 new genera had been added in the 11 years following the publication of Meyer's monograph.

BIBLIOGRAPHY.—*See* A. Meyer, "Acanthocephala," in Bronn's *Klassen und Ordnungen des Tierreichs* (Leipzig, 1932–33); H. J. Van Cleave, 'Relationships of the Acanthocephala," *Amer. Nat.*, 75(756):31–47 (1941). (H. J. V. C.)

**ACANTHOPTERYGII,** the most specialized section of the bony fishes (Teleostii), characterized by the possession of spines on the first dorsal fin and by the absence usually of a duct connecting the air bladder with the alimentary canal. (*See* FISHES.) They include the perch, the mackerel, the bass (*qq.v.*) and other well-known and important fishes besides numerous less noteworthy forms. In the perches and basses the anterior dorsal fin is armed with formidable spines.

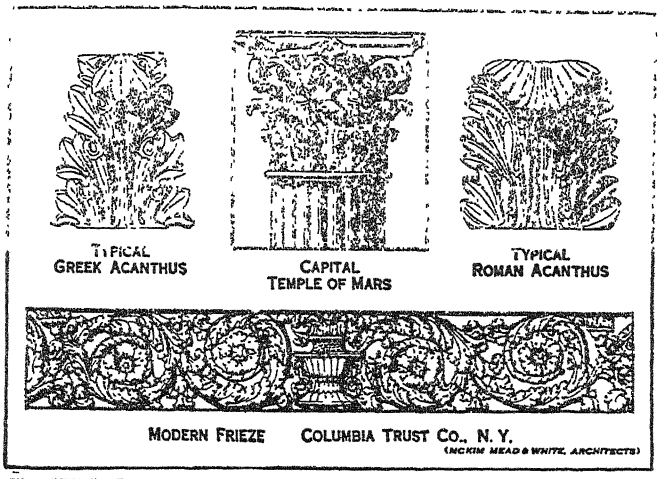
**ACANTHUS,** a genus of plants of the acanthus family (Acanthaceae), embracing some 20 species, mainly perennial herbs and small shrubs, native to the Mediterranean region and the warmer parts of Asia and Africa. They are bold, vigorous, handsome plants, with mostly broad, much divided, often spiny-toothed leaves. The erect stems bear stately spikes of showy white, purple or red flowers, surrounded by sharp-pointed, sometimes highly coloured bracts.

Several species are grown as ornamentals. These are mostly thistle-like plants, with stems 3 ft. to 4 ft. high, the best known of which is the bears' breech or brankursine (*A. mollis*), common in Mediterranean countries, with deeply cut, hairy, shining leaves, which are without spines, and whitish or rose-coloured flowers in spikes 1½ ft. long.

The spiny acanthus (*A. spinosus*), native to southern Europe, is so named because of its very spiny leaves. *A. perringi,* a native of Asiatic Turkey, with red flowers, is suitable for rock gardens. *A. montanus,* native to Greece, with roseate flowers, is grown in greenhouses.

In architectural decoration, the acanthus was first reproduced in metal, and subsequently carved in stone by the Greeks. It was afterwards, with various changes, adopted in all succeeding styles of architecture as a basis of ornamental decoration.

There are two types, that found in the *Acanthus spinosus,* which seems to have been followed by the Greeks, and that in the *Acanthus mollis,* which seems to have been preferred by the Romans.




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**A CAPPELLA** or **ALLA CAPPELLA,** Italian musical terms meaning literally "as in a chapel or church," whence they have come to be applied to compositions intended to be sung without instrumental accompaniment; or, alternatively, compositions accompanied in a particular way, viz., without the introduction of harmony or parts.

**A CAPRICCIO,** in music a direction signifying that the piece to which it is attached is of a fanciful, capricious nature, and is to be played in like manner.

**ACAPULCO,** a resort city and port of Mexico, at sea level on the Pacific coast in the state of Guerrero, 190 mi. S.S.W. of Mexico City. Pop. (est. 1950) 30,000, plus many transients. Acapulco has the best harbour on the Pacific coast of Mexico, and one of the finest natural anchorages in the world; it is situated on a deep, semicircular bay, nearly landlocked and accessible by land. Acapulco was a main depot for Spanish colonial fleets plying between Mexico, the Philippines and the orient, and continued to be a port of call for steamship lines running between Panamá and San Francisco as well as coastwise trading vessels. The town lies on a narrow strip of land between the bay and steeply rising mountains which encircle it. From May to November the climate is hot and humid, but from December through April it is warm and pleasant; February, March and April are almost rainless. Long a regional economic centre, Acapulco exports hides, cedar and fruit, as well as cotton, tobacco, cacao, sugar cane, Indian corn and coffee grown in the adjacent district of Tabares. No railways connect to Acapulco but a spreading network of highways and frequent air service make it accessible to visitors. Acapulco became "The Riviera of Mexico," deriving much of its livelihood from tourist trade.

A main highway, passing through Taxco and Cuernavaca, runs to Mexico City. (HD. C.)

**ACARNANIA,** a district of ancient Greece, bounded on the west by the Ionian sea, on the north by the Ambracian gulf, on the east and south by Mt. Thyamus and the Achelous. Its most populous region was the plain of the Achelous, commanded by the principal town Stratus; its people long continued in semi-barbarism, communication with the rest of Greece being impeded by mountain ridges and lagoons, but there were a few Corinthian colonies on the coast, founded in the 7th century B.C.; they were ruined in the 5th, through Athenian intervention. In 391 the Acarnanians submitted to Spartan control; in 371, to Theban. In the Hellenistic age they were constantly assailed by their Aetolian neighbours. But they remodelled their ancient cantonal league, apparently after the pattern of Aetolia, and in the 3rd century they formed a close alliance with Philip V. of Macedonia in his Roman wars. For their sympathy with his successor Perseus they were deprived of their federal capital Leucas and required to send hostages to Rome (167 B.C.). The country was desolated by Augustus, who drafted its inhabitants into Nicopolis and Patrae. Acarnania took a prominent part in the national uprising of 1821; it is now joined with Aetolia as a province. Several ancient sites in Acarnania have well-preserved walls, especially Stratus, Oeniadae and Limnaea.

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**ACARUS,** a genus of mites (*q.v.*), represented by the human itch-mite, *Acarus scabiei,* causing an irritating skin infection. The disease was known to the ancients, but its cause was discovered only in the 18th century. *See* Reuben Friedman, *Biology of Acarus Scabiei* (1942). (A. PH.)

**ACASTUS,** son of Pelias, but the friend of Jason; he took part in the Calydonian boar-hunt and the Argonautic expedition. After his father's death he instituted splendid funeral games in his honour. His wife Astydameia (called Hippolytē in Horace, *Odes* iii. 7, 17) fell in love with Peleus (*q.v.*), who had taken refuge at Iolcus, and accused him falsely to her husband (*cf.* BELLEROPHON; HIPPOLYTUS). Acastus thereupon left Peleus asleep on Mount Pelion, having first hidden his famous sword. On awaking, Peleus was attacked by the Centaurs, but saved by Cheiron. Having recovered his sword he returned to Iolcus and slew Acastus and Astydameia.

**ACATALEPSY.** In the history of philosophy the Greek term *acatalepsy* was first used by Pyrrho the sceptic to express the view that the human mind has no direct apprehension of material objects. One is consequently not justified in making assertions about what things really *are in themselves.* Each person can only say how things *appear to him.*

**ACAULESCENT,** a term used of a plant apparently stemless, as dandelion, the stem being almost suppressed.

**ACCADIAN,** an adjectival form of the name Accad or Akkad. Sumer and Akkad were the principal sub-regions of Babylonia (*q.v.*) and in view of the dialectical and ethnological differences between the peoples of the two regions, the terms Sumerian and Accadian came to represent the languages and ethnic groups of the two regions. (*See* SUMERIAN LANGUAGE.)

**ACCA LARENTIA,** in Roman legend, the wife of the shepherd Faustulus, who saved the lives of Romulus and Remus. Attempts have been made to explain the wolf legend by suggesting that Larentia was called *lupa* ("courtesan," literally "she-wolf") because of her immoral character (Livy i, 4; Ovid, *Fasti,* iii, 55). According to another account, Larentia was a beautiful girl whom Hercules won at dice (Macrobius i, 10; Plutarch, *Romulus,* 4, 5, *Quaest. Rom.,* 35; Aulus Gellius vi, 7). By his advice she married a wealthy Etruscan named Tarutius. She inherited his property and bequeathed it to the Roman people, who instituted in her honour a yearly festival called Larentalia (Dec. 23) According to some, Acca Larentia was the mother of the Lares and symbolized the fertility of the earth, in particular the city lands and their crops.

*See* Mommsen, "Die echte und die falsche Larentia," in *Romische Forschungen* ii (1879); E Pais, *Ancient Legends of Roman History* [illegible] D. Rouse, *The Year's Work in Classical Studies* (1907).

**ACCELERANDO** (Ital ), in music a direction signifying that the *tempo,* or speed of performance, is to be quickened.

**ACCELERATION,** as used in mechanics, a term denoting the rate of change in the velocity of a moving body. It is what the increment in velocity in a unit of time would be if the rate of change were uniform for that unit When a body falls in a vacuum near the earth's surface, the increment in velocity is about 32.16 ft. per second, and this is known as the acceleration of gravity. In astronomy the term has other uses, as when it refers to the time which the stars gain upon the sun in passing the meridian each day. (*See* MECHANICS; DIMENSIONAL ANALYSIS; GRAVITATION.)

**ACCELERATOR,** in a motor car (*q.v.*) the pedal which operates the throttle and thus controls the engine speed.

**ACCELEROMETER,** in aeroplane flight testing an instrument used to measure the acceleration of an aircraft in a defined direction The most common models consist substantially of a weight supported on a diaphragm or from a cantilever spring. By recording the movements of this weight during various manoeuvres of the aeroplane the accelerations undergone by the plane itself can be computed. With the accelerations known, designers can further compute the loads placed upon the structure of the aeroplane by manoeuvres, such as spins, loops and sharp pull-outs from dives, and adjust their structural strength factors accordingly. (*See* AEROPLANE.) (D. SE.)

**ACCENT,** a term used by the earlier Greek grammarians for the musical accent which characterized their own language, but later the term became specialized for quantity in metre, whence comes the Eng *prosody* (Lat. *accentus,* a literal translation of Gr προσῳδία) In all languages there are two kinds of accent: (1) musical chromatic or pitch accent; (2) emphatic or stress accent. The former indicates differences in musical pitch between one sound and another in speech, the latter the difference between one syllable and another which is occasioned by emitting the breath in the production of one syllable with greater energy than is employed for the other syllables of the same word. These two senses are different from the common usage of the word in the statement that someone talks with a foreign or with a vulgar accent.

In different languages the relations between pitch and stress differ greatly. The pitch accent is well marked, for example, in Lithuanian and Swedish. Modern Greek has changed from pitch to stress, the stress being generally laid upon the same syllable in modern as bore the pitch accent in ancient Greek. In the majority of European languages, however, stress is more conspicuous than pitch. To the existence of stress in the original language from which Greek, Latin, Celtic, Teutonic, Slavonic and other languages of Europe are descended, must be attributed a large part of the phenomena known as ablaut or gradation. In modern languages we get *Acton* out of the O.E. *āc-tūn* (oak-town), and more recently the contrast between *New Town* and *Newton.* The strong stress accent existing in the transition period between Latin and French led to the curtailing of long Latin words like *latrocinium* or *hospitāle* into the words which we have borrowed from French into English as *larceny* and *hotel.*

In both pitch and stress accent different gradations may be observed. In pitch, the accent may be uniform, rising or falling Or there may be combinations of rising and falling or of falling and rising accents upon the same syllable In ancient Greek there were (1) the acute (´), a rising accent; (2) the grave (`), apparently merely the indication that in particular positions in the sentence the acute accent is not used where it would occur in the isolated word, and (3) the circumflex, which as its form (^) shows, and as ancient grammarians state, combines the rising and the falling accent upon the same syllable, this syllable being always long. Different Greek dialects varied the syllables of the word; in historical times the accent had become limited to the last three syllables of a word. The theory that, as every vowel has its own natural pitch, and a frequent interchange between *e* (a high vowel) and *o* (a low vowel) occurs in the Indo-European languages, *e* originally went with the highest pitch accent, while *o* appeared in syllables of a lower pitch, has no certain foundation since there are many exceptions. Somewhat similar distinctions characterize stressed syllables. According as the strength of the expiration is greatest either at the beginning, the end or the middle of the syllable, the accent is a falling, a rising or a rising and falling one Syllables in which the stress is produced continuously whether increasing or decreasing are called single pointed, those in which a variation in the stress occurs without being strong enough to break the syllable into two are called double pointed There is no separate notation for stress accent, but the acute (´) is used for the increasing, the grave (`) for the decreasing stress. the circumflex (^) for the rising and falling (increasing and decreasing) and (˘) for the opposite. A separate notation is needed.

The relation between the two accents in the same language at the same time is a subject which requires further investigation In prehistoric times the stress in Latin must have rested upon the first syllable in all cases Only on this hypothesis can be explained forms like *peperci* (perfect of *parco*) and *collido* (a compound of *laedo*), for throughout the historical period the stress rested in these words upon the second syllable from the end.

Besides the accent of the syllable and of the word, there remains a more complicated problem, the accent of the sentence From earliest times some words have become parasitic or enclitic upon other words. Pronouns more than most words are modified from this cause, but conjunctions like the Gr τε ("and"), the Lat. *que,* have throughout their whole history been enclitic upon the preceding word. An important word may be enclitic, as in English *don't, shan't.*

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**ACCEPTANCE,** generally, a receiving or acknowledgment of receipt; in law, the act by which a person binds himself to comply with the request contained in a bill of exchange (*q.v.*), addressed to him by the drawer. Acceptance may be either general or qualified A general acceptance is an engagement to pay the bill strictly according to its tenor and is made by the drawee subscribing his name, with or without the word "accepted," at the bottom of the bill, or across the face of it Qualified acceptance may be a promise to pay on a contingency occurring, *e.g.,* on the sale of certain goods consigned by the drawer to the acceptor. No contingency is allowed to be mentioned in the body of the bill on pain of rendering the bill non-negotiable. But a qualified acceptance is quite legal and equally binding with a general acceptance upon the acceptor when the contingency has occurred. It is also a qualified acceptance where the promise is to pay only part of the sum mentioned

in the bill, or to pay at a different time or place from those specified. As a qualified acceptance is so far a disregard of the drawer's order, the holder is not obliged to take it; and if he chooses to take it he must give notice to antecedent parties, acting at his own risk if they dissent. A bill can be accepted in the first instance only by the person or persons to whom it is addressed; but if he or they fail to do so, it may, after being protested for non-acceptance, be accepted by some one else "*supra* protest," for the sake of the honour of one or more of the parties concerned in it, and he thereupon acquires a claim against the drawer and all those to whom he could have resorted.

For *acceptance of an offer, see* CONTRACT.

Acceptance has a further technical meaning in law in the case of delivery of goods pursuant to a prior contract for sale. Either an expression by the buyer of his assent to become owner, or his doing of some act inconsistent with the seller's ownership—such as selling or using part of the goods, will constitute such an acceptance. The effect is, in English law, to make impossible the later rejection of the goods, and leave the buyer a remedy in damages for any non-compliance of the goods with the contract. In some American States the acceptance, at least if not accompanied by an express claim of non-compliance, will wholly bar the buyer from any later claim that the goods were not up to contract. Under the prevailing American doctrine laid down in the Uniform Sales Act, however, the buyer can at his option if the goods accepted do not comply, either have damages, or return the goods and forego damages. If the contract is oral and no part payment has been made, both delivery and acceptance of some portion of the goods are necessary to make the contract enforceable at all. (X.)

**United States.**—In the United States trade acceptances are rediscountable at the Federal Reserve Bank if the date of maturity be not more than 90 days from the date offered for discount, except in the case of agricultural paper, for which the limit is 180 days. The Federal Reserve Bank shall take such steps as it deems necessary to satisfy itself as to the eligibility of any trade acceptance offered for rediscount and may require a recent financial statement of one or more of the parties to the instrument. To satisfy itself that the acceptance meets the primary requirement of arising out of a current merchandise transaction, the Federal Reserve Bank rules that "it must bear on its face or be accompanied by evidence satisfactory to the Federal Reserve Bank that it was drawn by the seller of the goods on the purchaser of such goods." Such evidence may consist of a certificate on or accompanying the acceptance to the following effect: *The obligation of the acceptor of this bill arises out of the purchase of goods from the drawer.* Such certificate may be accepted by the Federal Reserve Bank as sufficient evidence, provided, however, that the Federal Reserve Bank, in its discretion, may inquire into the exact nature of the transaction underlying the acceptance.

By the use of the trade acceptance, the seller of goods instead of having merely an open book account on a credit transaction, procures a negotiable evidence of the debt. The actual conversion of the original draft into a trade acceptance is accomplished when the buyer (drawee) writes across its face the word "accepted," together with the date and the place of payment, either at a banking house or at the place of business of the seller (drawer), and affixes his signature. Upon receipt of the accepted draft, the seller of goods (drawer) may either hold it to maturity and then collect, or discount it to procure immediate funds.

Authoritative information on current usage in connection with trade acceptances is published from time to time in the *Federal Reserve Bulletin* under "Rulings of the Federal Reserve Board" and "Opinions of Counsel of the Federal Reserve Board." (J. H. B.)

**ACCEPTILATION,** in Roman and Scots law, a verbal release of a verbal obligation. This formal mode of extinguishing an obligation contracted verbally received its name from the book-keeping term *acceptilatio*, entering a receipt, *i.e.*, carrying it to credit. The words conveying the release had to correspond to, or strictly cover, the expressed obligation.

**ACCESS,** approach, or the means of approaching. In law, the word is used in various connections. The presumption of a child's legitimacy is negatived if it be proved that a husband has not had access to his wife within such a period of time as would admit of his being the father. (*See* LEGITIMACY.)

In the law of easements (*see* EASEMENT), every person who has land adjoining a public road or a public navigable river has a right of access to it from his land. So, also, every person has a right of access to air and light through an ancient window. For the right of access of parents to children under the guardianship of the court, *see* INFANT.

**ACCESSION,** in law, a method of acquiring property adopted from Roman law, by which, in things that have a close connection with or dependence on one another, the property in the principal draws after it the property in the accessory, according to the principle, *accessio cedet principali.* Accession may take place either in a natural way, such as the growth of fruit or the birth of animals, or in an artificial way. The various methods may be classified as (1) land to land by accretion or alluvion (*q.v.*), (2) movables to land (*see* FIXTURES); (3) movables to movables; (4) movables added to by the art or industry of man; this may be by specification, as when wine is made out of grapes, or by confusion, or commixture, which is the mixing together of liquids or solids, respectively. In the case of industrial accession ownership is determined according as the natural or manufactured substance is of the more importance, and, in general, compensation is payable to the person who has been dispossessed of his property.

In a historical or constitutional sense, the term "accession" is applied to the coming to the throne of a dynasty or line of sovereigns or of a single sovereign. "Accession" sometimes likewise signifies consent or acquiescence. Thus, in the bankruptcy law of Scotland, where there is a settlement by a trust-deed, it is accepted on the part of each creditor by a "deed of accession."

**ACCESSORY,** a person concerned in the commission of a felonious offence, not as principal, but by participation; as by advice, command, aid or concealment. In certain crimes there can be no accessories, all concerned being principals, whether present or absent at the time of their commission. There is no accessory to misdemeanour.

There are two kinds of accessories—*before* the fact and *after* it. The first is he who commands or procures another to commit felony and is not present himself; for if he be present he is an abettor (*q.v.*). The second is he who, knowing a man has committed a felony, receives, harbours or assists him. An accessory before the fact is liable to the same punishment as the principal; and there is now indeed no practical difference between such an accessory and a principal in regard either to indictment, trial or punishment. Accessories after the fact are in general punishable with imprisonment (with or without hard labour) for a period not exceeding two years. (*See* the Accessories and Abettors Act 1861.)

**ACCIACCATURA,** in music, an old type of ornament in pianoforte and organ playing which consisted in reinforcing a particular note by striking simultaneously with it the note below it, the latter being then immediately released. (From Ital. *acciaccature*, to crush.) Nowadays it is more often applied to the shorter kind of *appoggiatura* (*q.v.*).

**ACCIAJUOLI, DONATO** (1428–1478), Italian scholar, was born at Florence and became gonfalonier of the city in 1473. His works are: a Latin translation of some of Plutarch's *Lives* (Florence, 1478); Commentaries on Aristotle's *Ethics* and *Politics;* and lives of Hannibal, Scipio and Charlemagne. In the work on Aristotle he had the co-operation of his master Argyropulos.

**ACCIDENCE,** the term for the grammatical changes to which words are subject in their inflections as to gender, number, tense and case (a mis-spelling of "accidents," from the Latin neuter plural *accidentia,* casual events). Also used for a book containing the rudiments of grammar, and so of any subject of art.

**ACCIDENT.** This term has a perplexing variety of meanings, which are, however, not entirely disconnected when considered historically. The meaning of the term varies with the antithesis intended. To this, accordingly, attention must be paid

in any context in which "accident" occurs. The following account deals with the principal antitheses and attempts to indicate the way in which the term "accident" acquired its various meanings.

(1) *Accident and Substance.*—Perhaps the oldest use of the term "accident" was by way of contrast with the term "substance" or "thing." "Substance" means the basic reality which has various qualities, stands in various relations, etc. These qualities, relations, etc., on the other hand, need a basis or support to qualify—they are "accidents," accessions to something that is there to bear them (substance). Among the schoolmen, accordingly, almost any quality was commonly called an accident; and this usage was fairly common even in the 17th century—"accident" and "substance" corresponding roughly to "quality" and "thing" respectively, as these terms are commonly used.

(2) *Accident and the Self-existing.*—In the strict sense of the term, as distinguished from its more usual meaning even among philosophers, the term "substance" means that which exists in itself and through itself, and when so interpreted its familiar contrast with "accident" naturally prompts the application of the term "accident" to *anything* that is dependent on some other thing. In this case, even what are commonly called "things" or "substances" will be classed among "accidents" Thus for Spinozism there is only one Substance, namely God, who alone is self-existing, while all finite things and even the so-called "infinite modes" (such as motion) are really "accidents," or dependent existents. Cartesianism, too, made this admission, or one very like it to all intents and purposes, but allowed the name "substance," in a qualified sense (that is, in the popular sense) to finite bodies and to souls.

(3) *Real Accidents.*—The antithesis between "accident" and "substance" just explained (2), clearly cuts across the distinction between "quality" and "thing," with which, according to one usage, it coincided more or less (1). Now, some of the schoolmen maintained that there are certain sense-qualities of things which are not dependent on the substances with which they are sometimes combined, but can exist by themselves, apart from such substances. These alleged independent or self-existing qualities they called "real accidents."

(4) *Accident and Essence.*—The distinctions between "substance" and "accident" explained in (1) and (2) naturally led people to regard an "accident" as something less important than substance, as something not *essential* to substance; and so the term "accident" was contrasted with whatever is not really essential to anything. Thus in logic, for instance, the so-called *fallacy of accident* is the erroneous assumption that a claim to know anything or anybody implies a knowledge even of all that is non-essential in relation to it or him. Similarly, in the doctrine of the Predicables (*q.v.*), as commonly expounded in books on logic, the predicable "accident" is contrasted with the other four predicables in the sense that any predicate asserted of a subject but not essential to it is called an "accident" of it, whereas any predicate essential to the subject of which it is affirmed belongs to one or other of the remaining predicables.

(5) *Accident, Necessity and Design.*—The kinship between what is "essential" and what is "necessary" has prompted the common use of "accident" for what is otherwise called a "chance" occurrence. And by a somewhat similar extension of its meaning the term "accident" has come to be applied in law to any occurrence or result that could not have been foreseen by the agent (because not necessarily involved in his action), or to a result not designed (and, therefore, presumably not foreseen), and lastly, to anything unexpected.

(6) *"Essential" and "Accidental" Accidents.*—One curious consequence of the multiplicity of meanings of "accident" is that by using the noun in the sense explained in (1) and the adjective in the sense explained in (4) the schoolmen distinguished between "essential" accidents and "accidental" accidents (*i.e.*, qualities).

**ACCIDENTALISM,** a term used (1) in philosophy for any system of thought which denies the causal nexus and maintains that events succeed one another haphazard or by chance (not in the mathematical but in the popular sense). In metaphysics, accidentalism denies the principle of universal causation, that is, the doctrine that everything occurs or results from a definite cause. In this connection it is synonymous with Tychism, a term used by C. S. Peirce for the theories (like that of Plato, *e.g.*) which make chance an objective factor in the process of the universe. Opponents of this accidentalism maintain that what seems to be the result of chance is in reality due to a cause or causes which, owing to the lack of imagination, knowledge or scientific instruments, we are unable to detect. In ethics the term is used, like indeterminism, to denote the theory that mental change cannot always be ascribed to previously ascertained psychical states, and that volition is not causally related to the motives involved An example of this theory is the doctrine of the *liberum arbitrium indifferentiae* (liberty of indifference), according to which the choice of two or more possibilities is affected neither by contemporaneous data of an ethical or prudential kind nor by crystallized habit (character). (2) In painting, the term is used for the effect produced by accidental lights (Ruskin, *Modern Painters,* I. ii. 4, iii., §4, 287). (3) In medicine, it stands for the hypothesis that disease is only an accidental modification of the healthy condition, and can, therefore, be avoided by modifying external conditions.

**ACCIDENTALS,** in music, are signs signifying that the notes to which they are attached have to be raised, lowered, or restored to their original pitch as the case may be. Thus a sharp (♯) raises a note a semi-tone, a flat (♭) lowers it a semi-tone, while a natural (♮) restores it once again to its former status. Each sign may also be doubled, though in the case of the double sharp, signifying the raising of the note by two semi-tones, the sign × is used instead of ♯♯; ♭♭, indicating a double flat, signifying the lowering of the note by two semi-tones; and ♮♮ serving to correct or cancel a preceding double-sharp or double-flat, although in modern practice a single natural (♮) is usually considered sufficient for this purpose. Accidentals introduced in the course of a piece apply only during the bar in which they occur, whereas when placed at the beginning of a composition, and constituting thereby what is called its signature, they govern the notes affected throughout the whole of the piece: but in the latter case they are not properly called accidentals. For explanation of origin and application of signs used for accidentals, *see* MUSICAL NOTATION.

**ACCIDENT INSURANCE, PERSONAL.** In England this type of insurance owed its origin to the risks of accident associated with early railway travel and even in the mid-20th century railway travel policies were common. Until 1908, when the Fatal Accidents (Damages) act was passed, payments under accident policies were generally applied to the reduction of damages payable to the injured person by a negligent third party After that time, personal accident insurances became increasingly popular, especially among salaried and professional men outside the benefits of Workmen's Compensation legislation.

**Accidents-only Policies.**—The commonest form of policy covers accidents only. The occupation and pastimes of the proposer are indicative of the hazard. Sedentary occupations are rated lowest while rates are graded up to those engaged in manual work, with the highest rates for work in connection with woodworking machinery and other work of unusual risk.

The accident-only policy provides for payment of benefits specified following "accidental bodily injury caused solely and directly by violent external and visible means." These words are used in their ordinary meaning, and when it has been necessary to refer cases to the courts it has always been shown that, provided the occurrence causing the accident has been something which was neither expected nor designed, then the expression "accidental" has been fulfilled. There must, however, be some sign of violence and there must also be a visible effect produced upon the person concerned. The benefits provided by such a policy are in the event of:—

| | |
|---|---|
| (1) Death | The capital sum. |
| (2) Total loss by actual physical separation at or above the ankle or wrist of two limbs, or the loss of sight of both eyes, or the loss of one limb and the loss of sight of one eye | The capital sum |
| (3) Total loss as in (2) of one limb or the sight of one eye | One-half of the capital sum. |

The above misfortunes must occur within three calendar months of the happening of the accident.

(4) Temporary total disablement from engaging in or giving attention to the insured's occupation Corresponding weekly benefit.
(5) Temporary partial disablement in similar circumstances. . . . One-third or one-quarter of benefit under (4).

The liability for the weekly payments is limited to 26 or 52 weeks, as the case may be, in respect of any one year of insurance. When one of the capital sums is payable no claim can be made for weekly compensation and if a payment has already been made for weekly compensation which is followed by a misfortune warranting a capital payment the total liability of the insurers cannot exceed the latter sum

**Accidents and Specified Diseases Policies.**—Such policies are similar to accidents-only policies but provide weekly benefits in addition for certain specified diseases Double benefits are provided if the insured person is killed or injured in an accident to a passenger lift, train, tramcar, omnibus or other licensed vehicle plying in the streets for public hire in which he is travelling as a passenger. An annuity is payable so long as the disability continues if the injury, while not entitling the payment of a capital sum, results in total disablement for not less than 12 months, or should the insured person lose completely the sight of both eyes by disease, or should he contract paralysis in at least two limbs, provided that this condition has existed for at least six months. Such policies are world-wide as regards accident cover, but cover for disease is restricted to civilized regions.

Cumulative bonus additions to the capital sums insured and discounts from premiums for life policyholders and to total abstainers are common features.

Provision can be made for the payment of medical expenses in connection with injuries or illness within the scope of the policy subject to a stated limit.

**Accidents and All Sickness Policies.**—Such policies are similar to those previously described, but in addition weekly payments are made to the insured if, as a result of any illness necessitating treatment by a qualified medical practitioner giving a certificate specifying the disease, he is confined to the house for not less than seven days and is totally disabled and prevented from attending to any part of his business. The period during which compensation may be payable varies between 26 and 104 weeks, though most insurers limit their liability to 52 weeks. Temporary partial disablement benefits are provided while the insured is convalescent, but the weekly payments are reduced to one-quarter of those payable for total incapacity by illness and the period is usually limited to four weeks. Such policies are terminated when the insured reaches the age of 60 and no payment is made for any illness contracted within four weeks after the commencement of the insurance. The illness risk is limited to the country in which the policy is issued, subject to the consent of the insurers should the insured propose to travel. A few insurers issue noncancellable accidents and illnesses policies. Such insurances are uncommon, but provided that the renewal premiums are paid the policy continues till the age of 55, when the insurance terminates. Premiums are calculated on an actuarial basis.

**General Policy Conditions.**—In the event of an accident the insured must, within 21 days, notify the insurers and send full particulars, accompanied by satisfactory medical evidence. The insured must, if required by the insurers, submit to a medical examination by the insurers' doctor and in the event of death the insurers are entitled to order a post-mortem examination at their own expense. If the insured changes his occupation he must notify the insurers and he must also advise them should he suffer any disease, physical defect or infirmity, thus giving the insurers an opportunity of reconsidering the risk. A cancellation clause is provided and the insurers may, by giving seven days' written notice to the insured, terminate their liability without prejudice to any claim which may arise prior to the termination of such notice. All differences arising out of the contract must be referred to arbitration.

**Sickness Indemnities.**—The benefits under such policies are similar to those provided by the accidents-only policy and in addition a weekly indemnity is provided for periods of continuous disability not exceeding 52 consecutive weeks If as the result of a disease or illness the insured loses the use of two limbs or the sight of both eyes the insurers will pay him, in lieu of any other indemnity, excepting surgical or hospital fees, the weekly indemnity specified in the policy during the period in which the insured is disabled up to a maximum of 100 weeks No payment is made for any disease for which the insured is not treated by a physician nor for any disease in respect of which disability commences while the policy is not in force

**Coupon Insurance.**—Before World War II there was a considerable growth in this class of business, which is generally undertaken by insurance companies on behalf of the periodicals concerned. The benefits, unlike those of the ordinary personal accident policies issued by insurance companies, apply only to more uncommon accidents and the weekly payments are generally very limited. Their most striking feature is the enormous capital sums which are offered as an inducement to buy the newspaper or magazine concerned.

**Group Personal Accident Schemes.**—Many commercial undertakings effect group policies to provide benefits for the whole of their employees falling within certain categories—generally the more highly paid staff who are not within the scope of the Workmen's Compensation acts. Such policies may be restricted to occupational accidents or may in some cases apply to any accident to any person within the scheme. The benefits provided are usually in a direct relationship to the earnings of the insured person and might take the following or similar form:

| | |
|---|---|
| (1) Death . . . . . | Two years' salary |
| (2) Permanent total disablement . | Two years' salary |
| (3) Permanent partial disablement | One year's salary |
| (4) Permanent total disablement . | First 13 weeks—full salary<br>Next 13 weeks—½ salary<br>Next 13 weeks—¼ salary<br>Next 13 weeks—¼ salary |

Compensation is not usually payable for more than 52 weeks in all and is not payable until the end of the disability.

It is unusual to require individual proposal forms from the respective employees to be included but the employer would be required to declare any disabilities or infirmities suffered, to his knowledge, by any person to be included. Premiums are calculated at a rate per cent based upon the estimated salaries of the grades of staff to be included subject to adjustment at the end of each period of insurance on the salaries actually paid.

**Aviation Risks.**—Most policies issued in Great Britain ordinarily exclude liability for accidents happening while the policyholder is "in on or about to enter or alighting from any vessel or machine made or intended for ascending in the air." Policies are freely extended, for additional premium, to cover flying risks while the policyholder is travelling as a fare-paying passenger. Some insurers issue policies to flying services personnel to cover them while they are flying other than operationally. Such policies generally exclude war risks. The commonest form of aviation personal accident insurance is by "coupon" taken out when booking a passage. Premium rates for travel by first-class air lines are very low indeed but higher rates are required for travel by others with less satisfactory facilities.

**War Risks.**—Practically all policies exclude the risk of death or injury due to war. War risks are, however, insured in connection with air travel at rates varying with the war hazards in the areas to be traversed. In wartime the unexplained disappearance of an aircraft may well be due to war, but in the absence of proof the claim will be met under the policy. In wartime, therefore, the premium for flying risks tends to rise and the premium for war risks may be relatively small. (A. G. M. B.)

## UNITED STATES PRACTICE

With regard to accident and health insurance in the United States, American practice differs in various details from that of Great Britain, though the general principles are the same. In America, the *proposer* is called the *applicant* and the *proposal* becomes the *application,* while the *capital sum* is styled *principal sum.* The word "indemnity" as used in American policies is

synonymous with "benefit," the amounts provided in the policies being classed as fixed or premeasured indemnity, regulated in amount by the ability or willingness of the insured to pay, and the policy becomes a valued benefit contract; there is no provision by which the amounts payable may be reduced in case of disability even though benefits payable under all insurance carried exceed the insured's earnings, but underwriters exercise great care against overinsurance in the original issue, requiring each applicant to certify that his earnings are in excess of benefits payable under all insurance carried and usually limiting the amount of insurance permitted to approximately three-fourths of the earnings.

There is never any right of subrogation in American policies by which the insured surrenders any claims against a third party who may be responsible for his injury. American policies do not carry a condition prohibiting the obtaining of additional insurance without consent of the company, but some contain a condition to the effect that if other insurance is obtained without notice to the company the amount of existing insurance is proportionately reduced. A great variety of accident policies, and a se of accident and health policies, is issued in America, with many variations in amounts payable and in the sundry features. With a fixed principal sum payable for accidental death and a fixed weekly benefit payable for disability, there may be variations in the percentage of principal sum payable for loss of eyesight, or for loss of one or more limbs, or even for the degree of loss of a particular limb. Likewise, many variations occur in the period for which disability benefit is payable. It may be limited to a specified number of weeks, varying from a few to many, or the period for which benefit is payable may be limited only by the period of disability. Under the most common practice no period limit is fixed in case of disability from accident, while a limit of fifty-two weeks in case of disability from sickness is most favoured.

Partial disability is usually provided for at the rate of 40% of the total disability rate in respect to disability caused by accidental injury, but is not generally provided for in case of sickness disability, though in some instances a certain provision may be made for partial disability, or disability not requiring confinement to the house may be classified as partial and a smaller benefit provided. The usual American accident policy provides specific sums for loss of life, limb or sight and a stated weekly benefit for disability, while the usual health policy, commonly combined with the accident policy into a single document, provides a stated weekly benefit for disability due to sickness with occasional additional payments in case of complete blindness or complete paralysis. Most accident policies contain a provision doubling the benefits payable in case of accidents occurring in public passenger conveyances, elevators or burning buildings, and some include in this class other hazards more or less incident to the risk of travel.

Other provisions common in American policies include additional payments against surgical operations, hospital treatment, nursing and payment of doctors' bills in the case of non-disabling injuries. Some include an optional clause under which in case of certain specified injuries, such as fractures and dislocations, the insured may elect to take a lump sum in lieu of the disability benefit. There is no real uniformity as respects the inclusion of these subordinate features. Some accident policies are of more restricted scope and may exclude from their coverage a certain class of accidents, specified in greater or less number, in which case proportionately less premium is charged. There is also a great variety of special or "limited" policies designed to insure only against a certain class or a small number of classes of accidents. These are often referred to as "coupon" insurance because generally sold by special advertising or offered as an inducement to purchase of goods, subscription to a newspaper or other periodical. Generally they apply to accidents of least common occurrence and because of that fact a merely nominal price is charged, and are issued upon receipt of coupons attached to the advertisement.

The insuring clause most commonly in use in America differs somewhat in wording from that in use in Great Britain. Usually it defines the insurance to be "against bodily injuries caused directly and independently of all other causes by accidental means," or by violent and accidental means, or by external, violent and accidental means, and there are other variations of verbiage without significant change of substance, the purpose always being to insure against the physical results of injury to the body caused wholly by accident, as distinguished from the natural processes following either wholly or partly from disease, degeneration or disintegration, which latter in case of disability becomes the function of health insurance and in case of death becomes the function of life insurance.

**Health Insurance.**—The most favoured form of health insurance in America insures against all sicknesses from whatever cause, and in such policies there are numerous variations. They may provide for all disability from the first day thereof to a specified period or without limitation. They may exclude from benefit the initial period of any disability and cover only disability after one week, or after a number of weeks or a number of months, with premiums varying in proportion. They may restrict payment of benefit to the period of confinement to house or may be without this restriction. They may exclude sickness contracted within a certain short period after the date of the policy or may cover any sickness contracted after the policy date. Additional payments may cover surgical operations, hospital treatment and nursing charges, or any or all of these may be omitted. Usually health policies stipulate that the insured must be under the treatment of a physician during any period for which disability may be claimed in order that there may be competent certification and that the necessary disability may be delimited as far as possible by proper care and treatment. So-called "limited" health policies are also issued to some extent, which confine their coverage to disability from certain diseases specifically named. Untold variations in this respect may be devised with proportionate variations in premium.

**Statutory Provisions.**—Those provisions of accident and health policies that relate to the performance and operation of the contract after issue are generally regulated by law. Many states have enacted statutes prescribing certain "standard provisions" which must be included in all such policies and prohibiting the inclusion of any contradictory or inconsistent conditions. Even in the states where such statutes have not been enacted it is the common practice of the companies to issue the same policies uniformly in all of them. These provisions govern such matters as the pro-rata reduction of the insurance in case of a change of occupation to one more hazardous, alterations or assignments of policies, reinstatement after lapse, the timely giving of notice and filing of proof of claim, examination by the company's physician in connection with claims, time for payment after proof, right of cancellation by insured in case of change of occupation to one less hazardous, rights of beneficiary, time when legal proceedings may be instituted. Certain other provisions may be included or omitted at the option of the issuing company. These permit reservation by the company of a right to cancel or to refuse to renew the policy, reduction of the amount of insurance in case additional insurance is obtained without notice, deduction from any benefit payable of premium then due and unpaid, limitation of the amount of insurance one person may have under various policies in the same company, limitation of the coverage within certain minimum and maximum age limits.

American policies do not require notice by the insured of a change of occupation, but the effect of such change, if any, is regulated by the statutory provisions. No notice is required from the insured of any change in his state of health except when it is to be made the basis of a claim for benefit. No arbitration clause is included in American policies, such a provision being commonly held illegal as tending to oust the courts of their jurisdiction.

**Physical Condition of Applicant.**—In the underwriting of both accident and health insurance the general physical condition of the applicant is given much weight, the application requiring disclosure of his present physical condition and past health record, which may influence the action of the underwriter even in the

issue of accident insurance where the state of health suggests susceptibility to more serious results in case of accident than would be common with a normal person, while both physical condition and health record are even more carefully considered when the application is for health insurance because of the possibly greater susceptibility to disease or sickness.

**Premium Rates.**—The premium rates for accident insurance are governed wholly by occupation, a basic rate first being fixed to cover the general hazards of life outside of the occupation and this rate being increased in proportion to additional hazards involved by the occupational exposure. For this purpose all known occupations are classified by the companies and they are brought into groups of relatively equal risk, resulting in some eight or more different rate classes as indicated by developed experience. Rates for health insurance do not commonly vary according to occupation, though benefit provisions often vary for the purpose of adjusting the cost in such occupations as involve particular exposure to occupational disease.

**Canadian Practice.**—In the dominion of Canada general practices and forms of policies are very similar to those of the United States and statutory standard provisions also are required, these being similar to those in use in the United States.

*See* M. W. Van Auken, *Ready Reference Digest of Accident and Health Insurance Law* (1922); S. S. Huebner, "Modern Insurance Tendencies," *Am. Acad. of Pol. Sci., Annals*, vol. cxxx, no. 219 (1927); S. B. Ackerman, *Insurance* (1939). (S. M. La M.)

**ACCIDENTS, INDUSTRIAL:** *see* Industrial Accidents.

**ACCIUS** or Attius, **LUCIUS,** Roman tragic poet, the son of a freedman, was born at Pisaurum in Umbria, in 170 B.C. He must have lived to a great age, since Cicero (*Brutus,* 28) speaks of having conversed with him. His plays, which are praised by ancient writers (Horace, *Epistles,* ii, 1, 56; Cicero, *Pro Plancio,* 24), were mostly free translations from the Greek, but a few (including *Brutus* and *Decius*) were on Roman subjects. About 700 lines are extant and are given in Ribbeck (*Tragic Lat. Relig.*).

Accius wrote other works of a literary character: *Didascalicōn* and *Pragmaticōn libri,* treatises in verse on the history of Greek and Roman poetry and dramatic art in particular; *Parerga* and *Praxidica* (perhaps identical) on agriculture; and an *Annales.* He also introduced innovations in orthography and grammar.

*See* M. Boissier, *Le Poète Accius* (1856); L. Müller, *De Accii fabulis Disputatio* (1890); O. Ribbeck, *Geschichte der römischen Dichtung* (1892); editions of the tragic fragments by Ribbeck (1897), of the others by Bährens (1886); F. Plessis, *Poèsie latine* (1909).

**ACCLAMATION,** in deliberative or electoral assemblies, a spontaneous shout of approval or praise (Lat. *acclamatio*), the adoption of a resolution or the passing of a vote of confidence or choice unanimously, in distinction from a ballot or division. In the Roman senate votes were passed by acclamation in such forms as *Omnes, omnes, Aequum est, Iustum est,* etc.; and the praises of the emperor were celebrated in prearranged sentences by the whole body of senators. In ecclesiastical councils vote by acclamation is common, the question being put in the form, *placet* or *non placet.* The Sacred college has elected popes by acclamation, when the cardinals simultaneously "acclaimed" one of their number as pontiff. In modern parliamentary usage a motion is carried by acclamation when approval is expressed by shouting such words as *Aye* or *Agreed.*

**ACCLIMATIZATION.** As in the case of so many words used by the biologist and physiologist, the word acclimatization is hard to define. With increase in knowledge and understanding, meanings of words change. Originally, the term acclimatization was taken to mean only the ability of human beings or animals or plants to accustom themselves to new and strange climatic conditions. A man or a wolf moves to a hot climate and is uncomfortable there; but after a time, he is better able to withstand the heat. But aside from temperature, there are other aspects of climate. A man or an animal may become adjusted to living at higher altitudes than those he was originally accustomed to. At ordinary mountain altitudes, this does not involve much of an adjustment to change in atmospheric pressure, for mountain climbers suffer more from lack of oxygen than from change in pressure. At really high altitudes, such as aviators may be exposed to, however, the low atmospheric pressure becomes a factor of primary importance. In changing to a new environment, a man may, therefore, meet new conditions of temperature or pressure, and in addition he may have to contend with different chemical surroundings. On high mountains, the amount of oxygen in the atmosphere may be relatively small; in crowded cities, he may become exposed to relatively high concentrations of carbon dioxide or even carbon monoxide; and in various areas, he may be exposed to conditions in which the water content of the atmosphere is extremely high or extremely low. Thus in the case of higher animals and man, the concept of acclimatization includes the phenomena of increased toleration of high or low temperature, of altered pressure, and of changes in the chemical environment.

Moreover, when we consider lower animals and plants, we find that the environment to which they are exposed may be very different from the environment of a terrestrial mammal. Fishes may live at or near the surface of the ocean, or they may live at great depths; also, a fish may live in fresh water or in salt water. The ability of an aquatic animal to change from one type of environment to another is the same sort of a phenomenon as the ability of a terrestrial animal to change from one climate to another. Numerous investigators have tried to transfer fish, clams, crabs, etc., from salt water to fresh, or from fresh water to salt, and they have examined the conditions which favour the success of such transfers. Unless we choose to draw artificial distinctions between one type of organism and another, we must adopt a very broad definition of acclimatization, a definition that will include all types of organisms and all types of environments. Let us define acclimatization, therefore, as the process in which an organism or a part of an organism becomes accustomed or inured to an environment which is normally unsuitable to it or lethal for it. By and large, acclimatization is a relatively slow process. The term should not be taken to include relatively rapid adjustments such as our sense organs are constantly making. This type of adjustment is commonly referred to by the physiologist as "adaptation." Thus our touch sense soon becomes accustomed to the pressure of our clothes and we do not feel them; we soon fail to hear the ticking of a clock; obnoxious odours after a time fail to make much impression on us; and our eyes in strong light rapidly become insensitive.

On the other hand, when an adjustment to an unfavourable environment requires several generations, this is scarcely acclimatization in the strict sense (although often in the past it has been so considered). If a species of animal or plant is moved to an unfavourable environment, the individuals of the species may, after a number of generations, be better able to withstand the unfavourable conditions than were the animals and plants that first moved into the new environment. This may not so much be due to any change or acclimatization during the lifetime of the original animals or plants or their descendants, but rather to changes or mutations from generation to generation. Such mutations are now known to be of relatively frequent occurrence (*see* Evolution, Organic; Gene). The mutations which are more apt to prosper in a given environment will tend to survive (as a result of natural selection); the unfavourable mutations tend to die off. So, for example, if wheat plants are moved to an excessively cold climate, during successive generations if mutations appear which are better able to withstand the cold, these mutant plants are the ones which will survive. This type of natural selection is well known, and it can indeed be hastened by artificial selection on the part of the agriculturist. The end result is to produce new strains or races of a species, better able to withstand a particular environment than was the original species. We are dealing here with a phenomenon familiar to students of heredity. The change in the species is a very different process from the acclimatization change which occurs during the life of an individual. If one considers the behaviour of a species for a number of generations, it is hard to distinguish between the changes produced as a result of mutation followed by natural selection and the changes produced as a result of true acclimatization.

The fundamental fact about acclimatization is that all animals and plants have some capacity to adjust themselves to changes in their environment. This is one of the most remarkable characteristics of living organisms, a characteristic for which it is extremely difficult to find explanations. Adjustment can be made to high or low temperatures, to changes in pressure or to changes in chemical environment. These various kinds of adjustment will be considered separately. But before entering into a logical treatment of the various facts and theories concerning the different types of acclimatization, an attempt will be made to present a brief discussion of the ability of various animals and plants to change their habitat from one region of the earth's surface to another. This subject has been studied primarily from the viewpoint of human welfare and human economy.

**Acclimatization of Various Species, Including Man.**—Early writers on biology and natural history, as well as early travellers and explorers, were interested in the possibility of importing animals and plants from one country to another. Tobacco, originally found in America, was introduced into Turkey and other countries. Cotton likewise was transplanted. Rubber and quinine, originally produced in South America, became staple crops of the East Indies. Flowers and shade trees found their way from one country to another. So, too, horses were imported into the Americas, and various other domestic animals were introduced into different parts of the world. Sometimes noxious insects or other types of pests find their way into countries originally free from them. The entrance of such undesirable organisms is a matter of great economic importance, but from our point of view it has no great theoretical interest. An animal or a plant from a strange country may be successfully introduced into the homeland, or it may not be able to live there. Usually the important variable is temperature. Some animals seem to be able to exist anywhere. Thus, as Charles Darwin pointed out in his *Origin of Species*, rats and mice can live in very cold climates as well as in the tropics. Some other animals are very sensitive to changes of temperature. Possibly, in part at least, the ability of rats and mice to live in different climates is due to their nocturnal habits. Both rats and mice are quite sensitive to high temperatures and are much more readily killed by heat than are cats and cows. It is very doubtful if rats or mice could withstand any lengthy exposure to the rays of the tropical sun.

Years ago, as new countries were discovered and developed, societies were founded to promote the exchange of species of animals and plants from one part of the world to another. The most famous of these societies was the Societé d' Acclimatation in Paris. Not always is the introduction of a species attended with any difficulty. Some species thrive away from their natural habitat, often even better than in their homeland. In such instances there is no need for the species to become accustomed or inured to the new habitat, and in reality acclimatization does not occur. The organism becomes naturalized but not acclimatized (*see* NATURALIZATION OF PLANTS AND ANIMALS).

The question of human acclimatization has interested historians, geographers, sociologists and medical men. The early Greek writers wondered why white men did not successfully colonize tropical countries. The difficulties of white settlers in the tropics are manifold, and the problems are extremely complex. It is hard to distinguish between the direct adverse effects of climate and the deterioration and death caused by the many types of tropical disease. In addition, the white man in the tropics often has had to face the competition of coloured races perhaps more capable of withstanding the heat. Then, too, the conditions of life are often strange and difficult and this may be a factor in the causation of what has been called "tropical neurasthenia." In modern times, when sanitary and health conditions have been improved, as in Panama and in northeastern Australia (eastern Queensland), acclimatization of white settlers is favoured. Some medical authorities have urged that if tropical disease could be prevented, white men in the tropics would prosper. Others have insisted that, quite apart from disease, the climate itself is harmful. Women are said to be paler in the tropics. In very hot regions, according to some observers, the effects of old age appear earlier. Some physicians claim that old-age vision (presbyopia), which in temperate climates usually is not noticeable until a man reaches the age of 45, may become evident in Europeans in the tropics about 10 years earlier. Hot climates have also been blamed for premature loss of memory.

Surprisingly enough, little attempt has been made to study the conditions which favour successful existence in hot countries. Of course air conditioning can change the climate within the home, and this, along with the introduction of modern methods of transportation, may eventually be a partial solution of the practical problem of life in the tropics. But on the physiological side, our knowledge is meagre. All authorities are agreed that excessive use of alcohol is fatal for anyone who attempts to live under conditions of excessive heat. Some Australian experts believe that manual labour is helpful to the health of dwellers in the tropics. Because salt is lost through the sweat, men in the tropics and workers in industries in which they are exposed to high temperatures are urged to eat salt occasionally. Presumably there are benefits from this practice, but they are not very great. Diet may be an important factor in determining human resistance to heat. It is generally agreed that in warm climates there is an unconscious tendency for people to choose diets lower in protein and fat and higher in carbohydrates. Such a practice is perhaps beneficial and there may be a theoretical reason why it should be. This will be brought out later.

As is well known, men can to some extent become acclimatized to life at high mountain altitudes. This acclimatization is primarily an adjustment to the low oxygen concentration of the air over the mountains. When a man first ascends a high mountain, his heart beats faster, and he becomes breathless; he may also be nauseated and vomit, his head may ache and his nose may bleed. After a short stay, these symptoms of mountain sickness tend to disappear. The physiological adjustment is somewhat complex, but for one thing there is an increase in the ventilation of the lungs, so that more air passes through them in any given interval of time. Also, the haemoglobin of the blood comes to have a greater affinity for oxygen than it normally possesses. In addition, the actual concentration of haemoglobin in the blood increases.

**Heat.**—In general, animals show a very definite ability to become acclimatized to temperatures somewhat above those they can normally withstand. To cite but a single example out of many, the common American black bass (*Micropterus salmoides*), if it is kept in warm water at a temperature of 86° F. for four days, becomes more resistant to heat. Normally, when these fish are exposed to high temperatures, 50% of them die when exposed for an hour to a temperature of 93° F., whereas those kept in the warm water for four days reached their death point only at a temperature of 100° F. Thus, their tolerance to heat had been raised approximately 7° F. On the other hand, when the fishes were kept for 16 days at a temperature of 50° F., half of them died when exposed to a temperature of 86° F. for an hour. Other fishes show a similar behaviour. Toad tadpoles raised in the warmth were found to be able to stand temperatures about 6° F. higher than those raised in colder water. Lower animals show a somewhat similar behaviour. Thus, for example, protozoa can be acclimatized so that they will withstand temperatures 4° or 5° (F.) higher than those temperatures which normally kill them. In the summer, as might be expected, animals are commonly better able to resist heat than in winter. Thus, in the case of the common sand crab of the Massachusetts coast (*Emerita talpodia*), the lethal heat temperature is 18° higher in summer than it is in the winter.

The mechanism of heat acclimatization is uncertain. In man, changes in the sweating mechanism or in the blood circulation may play a part. But only a few mammals sweat, and acclimatization to heat is very generally exhibited by all sorts of organisms, even by those which completely lack blood. As a matter of fact, essentially all living cells are heat sensitive, and the temperatures which kill them are often only a few degrees above those at which they are accustomed to living. In lower animals heat death is simply due to the death of the constituent cells. In

higher animals, some cells appear to be more sensitive than others, and the death or injury of these cells apparently produces toxic substances which injure and eventually kill the animal as a whole. At any rate, this is a commonly held view. In general, those organisms which are killed at the higher temperatures have more solid fats; that is to say, fats with higher melting points. This is a broad truth which holds both for animals and plants Thus fishes, which die at relatively low temperatures, have fats fluid at ordinary temperatures; whereas the warm-blooded mammals and birds have solid fats. Similarly, plants which live in the tropics seem generally to have more solid fats than those which live in temperate climates. Various experimenters have shown that when animals are reared at higher temperatures, their fats tend to become more solid. Such a change in the melting point of the fats may be a factor in the acclimatization of animals and plants to heat. It should perhaps also be pointed out that recent nutritional studies have shown that if animals eat sugar, the fat produced within the body from this sugar has a high melting point. Thus a diet rich in carbohydrate should be favourable for men or animals in the tropics, and this may perhaps be correlated with the fact already noted that men in hot countries seem unconsciously to prefer such a diet.

**Cold.**—There have been relatively few studies on the ability of animals to become acclimatized to cold. Fishes accustomed to warm water are unable to withstand sudden transfer to cold water. At Naples, the eggs of the sea urchin (*Paracentrotus lividus*) can not develop at temperatures below 61° F. in summer, but in the wintertime these eggs can develop at temperatures as low as 47° F.

In agriculture, the ability of plants to become acclimatized to the cold is a matter of great practical importance. Tropical plants are killed at temperatures above freezing. In cold countries, plants frequently suffer injury from frost. As a result of breeding experiments, and as a result also of chance mutations, cold-resistant varieties of wheat and other crop plants have been obtained, and these varieties have made farming possible in regions where it might otherwise have been impractical. But even for any given variety of a plant, some increase in so-called cold hardiness is possible. For when plants are grown at lower temperatures they are better able to withstand frost. However, they should not be grown at temperatures too close to the freezing point, for this is apt to weaken them rather than make them more hardy. When plants are exposed to the cold, there may be an increase in the amount of sugar or salt contained in the plant cells, and such increases would tend to prevent freezing. Possibly also, in hardy plants water is prevented from freezing by an increased tendency for it to be bound chemically in such a way that it does not act like ordinary water. Some workers believe that cold hardiness is primarily due to an increase in the amount of this "bound water." However, this explanation does not seem to fit all cases. A protein jelly, such as a gelatin gel, does not freeze as readily as a fluid protein solution. It is possible, therefore, that the state of fluidity of the vital protoplasm may be a factor in determining cold hardiness. At any rate, this has been suggested.

**Marine and Fresh-Water Acclimatization.**—Ordinarily, animals which live in the ocean die rather rapidly if they are placed in fresh water; also fresh-water animals die in sea water. This is not always true, for the eel and the salmon can pass from sea water to fresh water and back again without injury. If fresh-water animals are placed in water containing a large amount of salt, they tend to lose water from their cells; and in the case of simpler animals, there is a considerable loss of water. This is due to a process called osmosis, and osmosis also causes an inflow of water into the cells of a marine animal placed in fresh water. As a matter of fact, the cells of all animals are in equilibrium with the solutions in which they are bathed. If these solutions become more dilute, the cells increase in volume; if on the other hand, the concentration of the solutions is increased, the cells lose water and shrink. Many higher animals are enclosed in stiff integuments which prevent the free passage of water to the constituent cells and such animals are less sensitive to changes in the salt content of the outer medium; although, of course, within the bodies of the animals the cells are in equilibrium with the blood or other fluids of the animal.

Sea water contains many types of salts, but by far the most abundant of these is ordinary table salt (sodium chloride); and the concentration of salt in sea water is approximately the same as that of a 3% solution of table salt. If fresh-water animals, normally incapable of living in sea water, are placed in a very dilute salt solution and then salt is gradually added over a period of weeks or even months, it is in some instances possible to acclimatize the animals so that they can live in solutions as salty as or even saltier than sea water. Also, by gradually adding fresh water to the sea water in which marine forms are living, they can be made to live in solutions whose lack of salt would ordinarily kill them rapidly. Many experiments of this sort have been performed. Different types of animals vary widely in their capacity to become acclimatized. All sorts of adjustments are involved. Presumably, with an increase in salt content of the surrounding medium, both the cells and the body fluids of the animals become richer in salt. An important factor is the ability of an animal to excrete salt. Ordinary fishes are able to excrete salt through their gills and this aids them in their adjustment to the salt water of their surroundings. On the other hand, the excretion of water by animals enables them to get rid of excess water taken in through the skin. Thus, a frog immersed in water is continually taking up water through the skin and excreting it by way of the kidneys. Thus, obviously, excretory processes may play a part in the ability of animals to accustom themselves to changes in the salt content of their watery environment.

**Chemical Acclimatization.**—All sorts of organisms show some power of accustoming themselves to a wide variety of poisons. Bacteria and protozoa may acquire an increased resistance to such substances as mercuric chloride, quinine, etc. Such acclimatization becomes a factor in the treatment of disease, for protozoan and bacterial parasites which are normally killed by a certain concentration of a drug may after a time become resistant. Bacteria and protozoa reproduce very rapidly—the average length of life of a bacterium is only about 20 min—and accordingly, in studies of acclimatization in these lower organisms, the acclimatized organisms are descendants of the original organisms. Thus, in such experiments new types of organisms may arise in successive generations as a result of mutation. Some of these new mutated types may be more resistant than the original forms, and these more resistant mutations would tend to be selected out; that is to say, they would show a greater tendency for survival. Accordingly, in experiments with bacteria and protozoa it is hard to distinguish between acclimatization in the strict sense and changes primarily due to mutation and natural selection.

In higher animals, true acclimatization to chemicals undoubtedly occurs. Mice and rabbits can become somewhat acclimatized to the presence of carbon monoxide in the atmosphere. Man can train himself to eat increasing amounts of certain poisons and he can then acquire a tolerance for these poisons. Tolerance to poisons has been widely studied by pharmacologists Various types of explanation are possible. Thus, it has been thought that when a tolerance to arsenic is acquired, there is less absorption of the poison from the intestine. Tolerance to alcohol may involve a decreased absorption, an increased or more rapid excretion, a decrease in the amount of alcohol which reaches the brain, or an increase in the rate at which alcohol is chemically transformed within the body. Modern studies tend to disprove all these possibilities, and apparently human tolerance for alcohol is primarily due to an acclimatization of the cells of the central nervous system.

Many living organisms produce poisonous substances. Thus, toadstools are notoriously poisonous and so too are many higher plants; as well as scorpions, spiders, snakes, etc. In general, the organism producing the poison is immune to its effects. A man can be made tolerant to some particular variety of snake poison; that is to say, he is made immune to it. Similar immunity may be acquired for various bacterial poisons. The attempt to understand this type of immunity is of such importance to bacteriology and medicine that an entire science has been built around it.

One of the most interesting types of chemical acclimatization is that shown by bacteria and yeasts toward food substances in their environment. Yeasts commonly live by fermenting sugars, but normally they are capable of utilizing certain types of sugars and not others. If a yeast colony be grown in a medium containing an unusual type of

sugar, one which it does not have the power to attack, after a time it may acquire this power.

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**ACCOLADE**, a ceremony used in conferring knighthood; but whether it was an embrace (according to the use of the modern French word *accolade*), or a slight blow on neck or cheek, is not agreed. Gregory of Tours writes that the early kings of France kissed the knights on the left cheek; and William the Conqueror is said to have made use of the blow in conferring knighthood on his son Henry. At first it was given with the fist, but for this was substituted a gentle stroke with the flat of the sword on the side of the neck, or on either shoulder. In Great Britain the sovereign still employs this latter form. "Accolade" is also a technical term in music-printing for a sort of brace joining separate staves; and in architecture it denotes a form of decoration on doors and windows.

**ACCOLTI, BENEDETTO** (1415–1464), Italian jurist and historian, was born at Arezzo, in Tuscany. He was for some time professor of jurisprudence in the University of Florence, and in 1458 became chancellor of the Florentine Republic. In conjunction with his brother Leonardo he wrote in Latin a history of the first crusade, entitled *De Bello a Christianis contra Barbaros gesto pro Christi Sepulchro et Judaea recuperandis libri tres* (Venice, 1532; Italian trans., 1543; French trans., 1620), which, though itself of little interest, is said to have furnished Tasso with the historic basis for his *Jerusalem Delivered*.

His brother FRANCESCO (c.1416–c.1484) was also a distinguished jurist.

**ACCOLTI, BERNARDO** (1465–1536), Italian poet, born at Arezzo, was the son of Benedetto Accolti. Known in his own day as *l'Unico Aretino*, he acquired great fame as a reciter of impromptu verse. He was listened to by large crowds, composed of the most learned men and the most distinguished prelates of the age. His works were published at Florence in 1513 and have been several times reprinted.

His brother, PIETRO ACCOLTI (1455–1532), was made cardinal by Julius II. He was abbreviator under Leo X, and drew up in 1520 the bull against Luther. In 1524 he became archbishop of Ravenna.

Pietro's nephew, BENEDETTO (1497–1549), was also a cardinal, under Clement VII, and a writer of Latin verse.

*See* E. Guarnera, *Bernardo Accolti* (Palermo, 1901).

**ACCOMMODATION,** in theology has two chief meanings. (1) It is used to describe the method of adapting the presentation of truth to the learners' capacity. In a sense all revelation of God must be "accommodated" to man: the naked revelation would be so dazzling as to blind him. When Jesus withheld certain truths from the disciples because they could not yet bear them (John xvi. 12) he was practising accommodation. Teaching by symbol or parable, too, is accommodation. (2) When words used with a definite reference to one subject are applied to another subject we have accommodation in a more special sense. Thus Matthew ii. 15 states that Jesus was taken to Egypt that the word of the prophet, "Out of Egypt did I call my son," might be fulfilled: but the prophecy quoted, Hosea xi. 1, quite clearly means Israel by "my son."

In biology accommodation is used to describe adjustments achieved by an individual organism over and above those which it makes as part of its inheritance. In psychology it means "the process by which habit is modified, cancelled and added to" (J. M. Baldwin).

For accommodation in optics *see* OPTICS.

**ACCOMMODATION BILL:** *see* BILL OF EXCHANGE.

**ACCOMPANIMENT,** a musical term for that part of a vocal or instrumental composition added to support and heighten the principal vocal or instrumental part; either by means of other vocal parts, single instruments or the orchestra. Owing to the early custom of only writing the accompaniment in outline, by means of a figured bass (*q.v.*), to be filled in by the performer, and to changes in the number, quality and types of the instruments of the orchestra, "additional" accompaniments have been written for the works of some of the older masters, such are Mozart's "additional" accompaniments to Handel's *Messiah* (*see* article on HANDEL). In the case of songs an accompaniment may consist merely of a few chords of the simplest kind or take the most elaborate form and constitute the most striking feature of the composition. In the latter case the performance of such accompaniments calls for the highest skill and constitutes a distinctive branch of the pianist's art, demanding the amplest powers of execution and first-class musicianship, especially when the player is called upon, as sometimes happens, to transpose a difficult accompaniment at sight for the convenience of the singer. Accompanying is also an important branch of conducting, in the case of concertos, choral music, and so forth.

**ACCOMPLICE,** in law, one who is associated with another or others in the commission of a crime, whether as principal, abettor, or accessory (*q.v.*). Although the uncorroborated evidence of an accomplice is admissible in law, and may be acted upon by a jury, it is the duty of the judge to warn the jury that it is always dangerous to convict on such evidence, and he should advise them not to convict (*R.* v. *Baskerville*, 25 Cox. C C. 524).

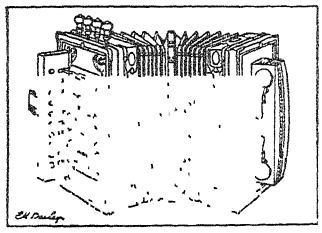
**ACCORAMBONI, VITTORIA** (1557–1585), an Italian lady famous for her great beauty and accomplishments and for her tragic history. She was born in Rome of a family belonging to the minor *noblesse* of Gubbio, which migrated to Rome. After refusing several offers of marriage for Vittoria, her father betrothed her to Francesco Peretti (1573), a nephew of Cardinal Montalto, who was regarded as likely to become pope. Vittoria was admired by the most brilliant men in Rome, and being luxurious and extravagant she and her husband were soon plunged in debt. Among her admirers was P. G. Orsini, duke of Bracciano, and her brother Marcello, wishing to see her the duke's wife, had Peretti murdered (1581). The duke himself was suspected of complicity as he was believed to have murdered his first wife Isabella de' Medici. They were married shortly after. But attempts were made to annul the marriage; Vittoria was imprisoned, and only liberated through the interference of Cardinal Carlo Borromeo. On the death of Gregory XIII., Cardinal Montalto, her first husband's uncle, was elected in his place as Sixtus V. (1585); he vowed vengeance on the duke of Bracciano and on Vittoria, who, warned in time, fled first to Venice and thence to Salò in Venetian territory. Here the duke died in Nov. 1585, bequeathing all his personal property to his widow. Vittoria, overwhelmed with grief, went to live in retirement at Padua, where she was followed by Lodovico Orsini, a relation of her late husband and a servant of the Venetian republic, to arrange amicably for the division of the property. But Lodovico hired a band of bravos and had Vittoria assassinated (Dec. 22, 1585). He himself and nearly all his accomplices were afterwards put to death by order of the republic.

About Vittoria Accoramboni much has been written and she has been greatly maligned by some biographers. Her story formed the basis of Webster's tragedy, *The White Devil* (1612), and of Ludwig Tieck's novel *Vittoria Accoramboni* (1840); it is told in D. Gnoli's vol. *Vittoria Accoramboni* (Florence, 1870), and an excellent sketch of her life is given in Countess E. Martinengo-Cesaresco's *Lombard Studies* (London 1902).

**ACCORD,** in law, an agreement between two parties, one of whom has a right of action against the other, to give and accept in substitution for such right any good legal consideration. Such an agreement when executed discharges the cause of action and is called *Accord and Satisfaction*. This specific form of pleading is obsolete in England.

**ACCORDION,** a small portable reed wind instrument with keyboard, one of the smallest members of the organ family, invented in 1829 by Damian, in Vienna. It consists of a bellows of many folds, to which is attached a keyboard with from five to 50 keys. The keys on being depressed, while the bellows are being worked, open valves admitting the wind to free reeds, the pitch of the note being determined by the length and thickness of the reeds. The right hand plays the melody on the keyboard, while the left works the bellows and manipulates the two or three bass harmony keys, which sound the simple chords of the tonic and

dominant. The archetype of the accordion is the cheng (*q.v.*) or Chinese organ, between which and the harmonium it forms a connecting link structurally. Improvements in the construction of the accordion produced the concertina (*q.v.*), melodion and melophone.



THE ACCORDION, ONE OF THE SMALLEST MEMBERS OF THE ORGAN FAMILY, WAS INVENTED BY DAMIAN, A VIENNESE, IN 1829

**ACCORSO** (ACCURSIUS), **MARIANGELO** (*c.* 1490–1544), Italian critic, was born at Aquila in the kingdom of Naples. He was a great favourite with Charles V., at whose court he resided for 33 years, and by whom he was employed on various foreign missions. He was the first editor of the *Letters of Cassiodorus*, with his *Treatise on the Soul* (1538); and his edition of *Ammianus Marcellinus* (1533) contains five books more than any former one. The affected use of antiquated terms, introduced by some of the Latin writers of that age, is humorously ridiculed by him, in a dialogue in which an Oscan, a Volscian and a Roman are introduced as interlocutors (1531).

**ACCOUNT,** a term of very various use in book-keeping, banking and stock exchange terminology (*see* BANKING AND CREDIT) indicating counting, reckoning, especially of moneys paid and received, hence a statement made as to the receipt and payment of moneys The following are some of its chief usages:—

*Balanced account,* an account in which the total debits equal the total credits and which has been ruled off to indicate that fact.

*Balancing account,* an account contained in a subsidiary ledger which shows in aggregate and also in reverse, as to debit and credit, the total of the detail accounts. The use of such an account makes a ledger self-balancing. The information contained in a balancing account is essentially that found in a *controlling account* although the debits and credits appear in reversed order in the *balancing account.*

*Closed account,* same as balanced account.

*Contra account,* an account of contrary tendency which must be considered with another account because of an interlocking relationship. For example, a customer of a business may also be a creditor. If the amount he owes as a customer is less than the amount that is due him as a creditor, the business may remit a check for the net amount. The term used in referring to the amount due from the customer in this case is *contra account.*

*Controlling account,* an account in the general ledger which reflects in aggregate the details of two or more accounts of the same tendency. Ordinarily the underlying accounts are operated in a subsidiary ledger.

*Impersonal account,* an account which is not a *personal account.* Any expense or income account is an impersonal account.

*Mixed account,* an account containing two or more separate classes of transactions. The "merchandise account," for example, contains a record of purchases, sales, purchase returns, purchase allowances, sales returns, sales allowances, freight and cartage, etc. In modern accounting, a separate account called a *simple account* is maintained for each class of transactions.

*Nominal account,* an account which reflects a change in the financial condition of a business. Thus, it is an account which finally finds its way into the profit and loss account; *e.g.,* sales, purchases, interest, discount, salaries, wages, commission and advertising expense. All of the accounts appearing in a statement of income, and profit and loss, are *nominal accounts.*

*Open account,* an account which is not in balance, *i.e.,* an account containing a debit or a credit excess; opposite of *closed account.*

*Personal account,* an account operated under the name of an individual, an organization or a business enterprise.

*Private Account,* an account maintained in a Private Ledger. Information of a confidential nature which ought to be shown on the accounting records can best be treated in the private set of accounts.

*Real account,* an account used in displaying the financial status of a business. All accounts used in a "balance sheet" are real accounts; thus they represent assets, liabilities and capital.

*Simple account,* an account containing entries relating to a single class of transactions; opposite of mixed account. Sales returns, purchase allowances, interest on notes receivable and administrative salaries are *simple accounts.* (*See* ACCOUNTANCY AND ACCOUNTANTS; BOOKKEEPING )

As a stock exchange term, "account" is used in several senses:—

(1) The periodical settlements occurring, in London, monthly for British Government and a few other first-class securities, and fortnightly for all others.

(2) The period between two settlements. A 19-day account is one in which 19 days elapse between one pay day and another.

(3) The volume or condition of commitments. A speculator is said to have a large account open when he has dealt heavily either for the rise or fall.

An account is also any statement as to acts or conduct, or quite simply any narrative report of events, etc. A further sense-development is that of esteem, consideration. (G. L. C.)

**ACCOUNTANCY AND ACCOUNTANTS.** Originally, accountancy was the same thing as account-keeping or bookkeeping, and "accountant" and "bookkeeper" were interchangeable terms, but an increasing recognition of the importance of accounting in the development of modern business methods has led here, as elsewhere, to the division of labour. In the early days of navigation it was doubtless reasonable to assume that the man who navigated a canoe was in all probability also the man who designed and constructed it: to-day, the distinctions between the engineer officer, the naval architect and the shipbuilder are clearly defined and well recognized. Much the same process of evolution has been going on in the accountancy world, and although the distinction may not yet be universally accepted, it may be stated that, whereas the bookkeeper is the person who keeps the books or accounting records of an undertaking, the accountant is rather the person who decides how such records ought to be kept. The term accountancy is now generally applied to all the work that falls to the lot of the accountant, although under modern conditions (as is shown later on) that work is now exceedingly varied and often extends far beyond the region of accounts.

**Early History.**—Very little is known of the origin of accountancy as a profession. In the modern acceptation of the word, however, a professional man is one who places his skill and learning at the disposal of all and sundry for a reward, as distinct from one who serves a single employer. Accordingly, while there are several references in mediaeval and even classic times to stewards and auditors, these references do not throw much light upon the origin of professional accountancy, as the persons referred to were manifestly in the whole-time employment of a single individual or body. The first association of accountants of which there is any record is the *Collegio dei Raxonati,* which was founded in Venice in 1581, but it is by no means certain that the members of this body were professional or public accountants, or whether they were not rather employees of public bodies. At Milan, however, in 1742, the Government established a scale of charges for accountants, so it may be assumed that then, if not earlier, professional accountancy (as here defined) actually existed in that city. It has been said that the first Scottish professional accountant was one George Watson, born in Edinburgh in 1645; but whether he was really able to carry on a practice as a professional accountant in addition to his "large private banking business" seems somewhat doubtful. Holden's *Triennial Directory of London, Westminster and Southwark* was first published in 1799, and contains the names of 11 accountants. The *British Universal Directory,* published in 1790, had given the names of five accountants only. It seems clear, therefore, that there was very little professional accountancy in London before the 19th century, and in the issue of *Holden* for 1822 the number of practising accountants had only risen to 73. Indeed, little progress was made by professional accountancy in Great Britain, or elsewhere, until the middle of the 19th century, when (so far at least as Great Britain is concerned) it received a great impetus from

the growth of limited liability companies, and a little later from the Bankruptcy Act, 1869, which to a very large extent withdrew the administration of insolvent estates from the hands of public officials. The advent of the limited liability company led to business operations being undertaken upon a scale which had formerly not been thought of. The proper control of these large scale operations naturally called for better accounting systems than had formerly been deemed adequate.

**Organization.**—The first step in the direction of organizing professional accountancy in Great Britain was taken when the *Society of Accountants* in Edinburgh was incorporated by Royal Charter in 1854. Similar societies in Glasgow and Aberdeen were also incorporated by Royal Charter in 1855 and 1867 respectively. Each of these bodies, however, had assigned to it definite geographical limitations, although the individual members of all three may, and do, practise in various parts of the world. The *Institute of Accountants* was formed in London in 1870, was incorporated by Royal Charter in 1880 as *The Institute of Chartered Accountants in England and Wales,* provision at the same time being made for all accountants then practising in England or Wales to become members. *The Society of Incorporated Accountants and Auditors* was registered under the Companies Act in 1885. (For particulars of these and other bodies *see* ACCOUNTANTS' SOCIETIES.) *The Institute of Chartered Accountants in Ireland* was incorporated in 1888.

**Accountancy Elsewhere.**—But little development has as yet taken place on the continent of Europe as regards professional accountancy, but professional bodies have existed in Holland, Sweden and Belgium since 1895, 1899 and 1903 respectively. Most British colonies have one or more professional bodies of their own.

**Duties.**—It has been stated that originally accountants were bookkeepers. Hence, naturally, as soon as the necessity or desirability of checking, criticizing or auditing the records of accounting parties was appreciated, skilled accountants whose probity could be relied upon would naturally be selected for the work. In the first instance, accordingly, professional accountants were in the main auditors of other people's accounts. Where the auditing was not a whole-time job there were obvious economies in securing the services of a professional accountant, while the fact that he was a professional accountant ensured his independence. As, however, the centre of gravity tended to shift in Great Britain from agriculture to industry, the professional accountant found thrust upon him an ever-enlarging sphere of activities over and above his primary function as an expert in accounts. Thus, professional accountants are frequently called upon to design systems of accounting (in recent times increasingly mechanized) for new or growing concerns; to assist in the establishment of an adequate system of cost accounts; to prepare business statistics; to investigate accounts in connection with partnership changes, the amalgamation of business interests, or the flotation of companies formed to acquire established businesses; to deal with compensation cases on the compulsory purchase of businesses by railway companies or public bodies; to give expert evidence on matters relating to accounts; to prepare accounts for the use of counsel; and to act as arbitrators in differences relating to matters of accounts or finance. Besides acting as directors of companies, dealing mainly with financial affairs, they also very frequently act as secretaries of companies whose operations are not upon a sufficiently large scale to justify a whole-time appointment, and the accounts of executors and trustees under wills and settlements are often kept by professional accountants. In addition, professional accountants act as trustees in bankruptcy; trustees under deeds of arrangement; liquidators of companies; receivers for debenture holders; and managers of businesses where a receiver is in possession of the assets.

**Mode of Entering the Profession.**—Anyone desirous of becoming an English chartered accountant must first serve under articles with a practising member for five years, or three years in the case of graduates. A premium of from 150 to 500 guineas is usually required. Before signing articles, the pupil must have passed the preliminary examination of the Institute, or some accepted equivalent of matriculation standard. After half the period of articles has expired, the pupil may submit himself for his intermediate examination in general commercial knowledge, bookkeeping and accounts and auditing; on the termination of his articles, before admission as a member, he must pass his final examination in advanced bookkeeping and accountancy (including costing and taxation); auditing; partnership and executorship law and accounts (including the rights and duties of executors, trustees and receivers); bankruptcy and company law; the principles of mercantile law and the law of arbitrations and awards; and either (*a*) economics, (*b*) banking, currency and foreign exchanges or (*c*) actuarial science. The regulations of the Society of Incorporated Accountants and Auditors similarly provide for articles of clerkship with a practising incorporated accountant, and the society's examinations must be passed For candidates who for any reason are unable to enter into articles, the society provides an alternative method of qualifying by nine years' approved experience in lieu of five years' articles. The nine years' experience must be gained in the office of a practising incorporated or chartered accountant, or—subject to certain conditions—of a municipal or county treasurer or accountant.

The regulations of Scottish chartered accountants as to admission, etc., are upon similar lines, there being a general examining board which deals with candidates articled to members of all three bodies. In Scotland as a rule no premium is charged, but no salary is paid during the period of articles. The Institute of Chartered Accountants in Ireland also has similar regulations.

**Statutory Regulations.**—In New Zealand and the Transvaal there are statutory registers of public accountants, and only those upon the register are permitted to undertake certain specified accountancy duties. The registration of professional accountants has been mooted at various times from 1889 onwards, but opinions are so divided as to its desirability that statutory registration in Great Britain seems as far off as ever.

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**United States.**—Accountancy, in the United States, is among the newer professions. In the short time of its existence it has not acquired the traditions which characterize such of the older professions as law, medicine and theology. The first formal recognition was given to accountancy in the laws of New York State in April 1896. Since that time all of the States have officially recognized the public accountant by creating the title, certified public accountant (C.P.A.), such title to be granted or awarded to applicants who satisfy the requirements regarding character, education and professional skill of the State in which recognition is sought. While there is still a lack of uniformity among the several States in the matter of requirements, there is a constant tendency toward greater strictness as laws are modified and new legislation enacted.

As indicative of the requirements imposed by State laws, the following summary sets forth the standard maintained by New York State: (*a*) an applicant for the certificate of certified public accountant must submit evidence that he is over 21 years of age and of good moral character; (*b*) he must have completed at least four years of high-school and since January 1, 1938, must also have completed a course in a college of accountancy registered by the department of education; (*c*) he must submit evidence of five years' experience in accountancy, at least two of which must have been in the office of a certified public accountant and of no less grade than that of junior accountant; such two years' accounting experience must have been in the office of a certified public accountant in this State or in the office of one residing in another State holding a certificate from such State granted on no lower requirement than that of this State, and he must submit evidence of three years' experience attained prior to his admission to the C.P.A. examination; (*d*) he must take professional examinations conducted by the State department of education in the following subjects: theory of accounts, auditing,

practical accounting and commercial law. The passing grade in each subject is 75% A candidate who fails in one subject only may take a subsequent examination in that subject to be given within two years from the date of the examination at which he passed the other three subjects.

In the United States, as in other countries, a high standard of professional ethics is fostered. The accountant acting as custodian of his client's interests must safeguard them in every legitimate way. His service to the client carries with it a strict responsibility to the client which cannot be divided or escaped. Confidences of the client must be held inviolable. The acceptance of contingent fees is frowned upon by members of the profession. As an obligation to the client, the accountant must keep himself informed on current developments in the profession.

Education for accountancy, in the United States, was formally provided for as early as 1881. In that year the Wharton School of Finance and Economy of the University of Pennsylvania was established. In 1898 the University of Chicago opened its College of Commerce and Politics (later known as the School of Commerce and Administration), and the University of California its College of Commerce. Two years later there were established at New York university the School of Commerce, Accounts and Finance; at Dartmouth college the Amos Tuck School of Administration and Finance; and at the University of Vermont, a department of economics and commerce. In the first quarter of the new century business education developed throughout the entire country so that at the opening of the year 1925 about 183 American colleges and universities provided instruction in business. In practically all of these schools, education for accountancy has dominated the business curricula.

*See* T. A. Budd, *The Interpretation of Accounts* (1927); R. B. Kester, *Accounting Theory and Practice* (1933) and Sanders, Hatfield and Moore, *Statement of Accounting Principles* (1938).

(J. T. MA.; X.)

**ACCOUNTANT-GENERAL,** a former official of the court of chancery, whose duties have been transferred to the paymaster-general.

**ACCOUNTANTS' SOCIETIES.** Under British law there is no restriction on the right to practice as an accountant, although the designations of the recognized professional bodies (*e.g.*, "chartered" and "incorporated" accountant) are protected by decisions of the courts, which have confined their use to members of the body concerned.

Until the passing of the Local Government Act, 1933, generally speaking only chartered or incorporated accountants could audit the accounts of municipal corporations, but under that act a municipal corporation may adopt either the system of district audit (by district auditors of the Ministry of Health) or professional audit. In the latter event the auditors must be members of one or more of the following: (1) Institute of Chartered Accountants in England and Wales, incorporated by royal charter in 1880; (2) Society of Incorporated Accountants and Auditors, incorporated in 1885, and with branches throughout the British Dominions; (3) Society of Accountants in Edinburgh (the earliest, formed in 1854); (4) Institute of Accountants and Actuaries in Glasgow; (5) Society of Accountants in Aberdeen; or (6) The Association of Certified and Corporated Accountants, formed in 1939 by the amalgamation of the Corporation of Accountants and the London Association of Accountants. There are other statutory limitations on the right to act as auditor in certain cases. No qualification is laid down for the auditors of limited companies, but it is usual for such appointments to be made from among the members of the older bodies There is a body of chartered accountants in Eire.

**United States.**—In the United States there are societies of certified public accountants. In addition to the various State societies there are several important national organizations the chief of which, the American Society of Certified Public Accountants and the American Institute of Accountants, were amalgamated in 1937 under the latter title. The National Association of Cost Accountants is composed of professional accountants and others whose interests lie in the cost phases of accounting. For information regarding American professional requirements, *see* ACCOUNTANCY AND ACCOUNTANTS.

**ACCOUNT CURRENT,** a running account which is likely to extend over an interminable period and which, if balanced, is usually opened again immediately; *e. g.*, a holding company which markets merchandise may have an account current with a subsidiary company which manufactures a product. The entire output of the factory may be turned over to the holding company and periodic charges made for merchandise thus transferred. The holding company may make advances from time to time to cover values received. Thus the account may not be in balance for a considerable time although an accurate statement of debits and credits will always be available in the account current. Merchants who sell on consignment frequently maintain accounts current with their consignees. An account current differs from the usual trade account in that the latter is usually settled at regular intervals, monthly, seasonally or otherwise. (G. L. C.)

**ACCOUNT RENDERED,** an expression used in referring to an account a statement of which has already been delivered to the customer. In business it is customary, for the purpose of verification, to send to each customer whose account is not in balance a statement showing the debits (charges) and credits for the current period (usually one month). If this balance is not liquidated before the end of the following period, the next statement of account has as its first entry "Account rendered" or "To account rendered" and the unpaid balance is shown. Thus an economy of time results because it becomes unnecessary to include all items arising since the account was last in balance.

(G. L. C.)

**ACCOUNT SALES,** a financial statement rendered by a merchant who has received goods on consignment showing sales, charges (usually commission and guaranty), and a net amount either credited to consignor's account or remitted by cheque. This form of financial statement is used extensively by commission merchants and factors and serves the consignor or principal as a basis for accounting.

ACCOUNT SALES
of merchandise received from
A. B. BLANK
to be sold for his account and risk
RENDERED BY BLACK AND WHITE, 27 WASHINGTON ST.,
NEW YORK CITY, *April 15, 19—*

| | | | |
|---|---|---|---|
| 19— | | | |
| April 4 | Received: | | |
| | Lot No. 3 . . . . . | | $1,200.00 |
| | SALES | | |
| April 8 | Lot No. 3 . . . . . | | 1,450.00 |
| | CHARGES | | |
| | Freight and cartage . . . | $37.50 | |
| | Commission 5% . . . . | 72.50 | 110.00 |
| E.&O.E. | Net proceeds by cheque enclosed | | $1,340.00 |

(G. L. C.)

**ACCOUNTS PAYABLE,** in accounting terminology, amounts owed by a business to its creditors and not evidenced by notes, bonds, acceptances or other recognition. Loans from officers or partners of an enterprise should be considered as loans payable rather than accounts payable; creditors' accounts with debit balances should be listed as other accounts receivable rather than as a deduction from accounts payable. In its broader sense, the term includes amounts received in advance for merchandise that has not been shipped, rentals received in advance, etc.

**ACCOUNTS PAYABLE LEDGER,** a subsidiary ledger containing the accounts of creditors. It is a device used to facilitate the bookkeeping of a business enterprise. The operation of this type of ledger makes possible a division of labour in an accounting department; the work of posting to creditors' accounts can be carried on independently of the work on customers' accounts and general ledger accounts. The sum of the account balances in the accounts payable ledger should agree with the balance of accounts payable controlling account as shown in the general ledger. (*See* BOOKKEEPING.) (G. L. C.)

**ACCOUNTS RECEIVABLE,** in accounting terminology, amounts due to a business by its trade debtors for merchandise sold to them, or for services rendered, on a credit basis. It should be noted that only obligations arising from trade transactions should be included. Loans to officers of a company should be considered as loans receivable rather than accounts receivable; creditors' accounts with debit balances should be listed as other accounts receivable rather than as a deduction from accounts payable. In the preparation of a balance sheet, this term, without qualification may be assumed to represent items which can be collected within a period usual to the trade or industry of which the business is a part. In its broader sense, the term includes all unsettled claims against debtors which are not represented in the form of bonds, promissory notes or trade acceptances

(G. L. C.; X.)

**ACCOUNTS RECEIVABLE LEDGER,** a subsidiary ledger containing the accounts of customers. In a business organization which sells on credit to many customers, it is impracticable to keep customers' accounts in the general ledger The necessity of having several clerks posting the accounts at the same time makes a segregation imperative An additional advantage lies in the greater ease with which errors can be localized. In a small business with a limited number of accounts, one accounts receivable ledger will suffice; in a larger business involving many thousands of accounts, 15 or 20 customers' ledgers may be required. The grouping of accounts is usually arranged on an alphabetical basis; *e.g.*, if two such ledgers are used, one would contain accounts of customers whose names start with letters from A–K, and the other, L–Z. Sometimes the grouping is arranged on a territorial basis; *e.g.*, a separate ledger might be kept for the customers served by each branch office of a business, in which case the names would be arranged alphabetically in each ledger. The accounts receivable ledger is kept in agreement with the general ledger by means of controlling account; the total of the balances of customers' accounts should agree with the balance in the controlling account. Ordinarily, a separate controlling account is kept for each accounts receivable ledger. (*See* BOOKKEEPING.)

(G. L. C.)

**ACCOUTREMENT** (a French word, probably derived from *à* and *coustre* or *coutre,* an old word meaning one who has charge of the vestments in a church), clothing; apparel; a term used especially, in the plural, of the military equipment of a soldier other than his arms and clothing.

**ACCRA,** capital and largest city of the Gold Coast dependency. Pop.: 135,456, census of 1948 (2,712 non-Africans). Although situated only 5° 37′ N. (0° 10′ W.), it benefits from being on the one reach of the Guinea coast having a marked dry season and small annual rainfall (29 in. falling on 68 days), and correspondingly sparse vegetation. Originally, and still, an African fishing station, it takes its name from *Nkran* (ant), by which the inhabitants were known to the tribesmen of the forested interior. Its site is a wave-cut cliff 25 to 40 ft. high, which projects at three readily defensible points to form coves that provide partial shelter for the landing of dugouts and surfboats. For three centuries after the Portuguese built the first European fort, about 1565, control of these landing places was hotly contested. Between 1642 and 1673 the Danes fortified the easternmost promontory (Christiansborg), the Dutch built Ft. Crèvecoeur 1½ mi. to the west; and the English erected Ft James on the point ½ mi. farther along. After changing hands repeatedly in combat, the first two were purchased by the British government from their original owners in 1850 and 1868, respectively. The capital of Gold Coast colony (the coastal settlements) was brought from Cape Coast castle (*q.v.*) in 1876. Administration of the remaining area of the dependency was added: Northern Territories protectorate in 1897, Ashanti in 1901 and Togoland mandate in 1922. Christiansborg remains as the compound in which Government House has been built. Parts of the other forts exist in downtown Accra. Africans occupy most of the older residential area near the business district, and suburbs have been laid out exclusively for them within a mile or two. The land between the town and Christiansborg is devoted to public purposes, largely administrative functions. Adjacent and on higher ground stands the European residential quarter Beyond it is the military headquarters of the dependency, and an airfield used for regular service after 1937 by Imperial Airways During World War II this dry and open plain was converted into an air base to serve as the principal landing for planes crossing the Atlantic, and as the West African headquarters for the United States air transport command.

Six miles north of the centre of town is Achimota, where the Prince of Wales college was opened in 1927. It is the ranking educational institution in west Africa, teaching Africans from kindergarten through college Government services, not duplicated elsewhere in the dependency, include a hospital where nurses are trained, a training depot for policemen, an asylum for mental cases, the Central Agricultural laboratory and the supreme court. Water is piped throughout the settlement, and there are municipal baths.

A jetty about 450 yd long extends the protection of the Ft James promontory by further reducing the impact of the surf along the harbour front. In its lee a lighterage pier reaches beyond the breakers, but need be used only during the season of highest surf. The leading export is cacao, most of which comes by rail from points as far inland as the terminus, Kumasi. Roads usable throughout the year reach all sections of the dependency, but many are roundabout.

Under the constitution inaugurated in 1945, Accra elects two of five municipal members of the governor's legislative council. The municipal council, set up in 1894, was reconstituted in 1943 with a majority of African members and also a majority of elected members.

(D. WH.)

**ACCRETION,** an addition to that which already exists; increase in any substance by the addition of particles from the outside. In law, the term is used for the increase of property caused by gradual natural additions, as on the seashore or on a riverbank or by the formation of a riverine island. (*See* ALLUVION.)

**ACCRINGTON,** municipal and parliamentary borough, Lancashire, England, 23 mi. N.W. of Manchester, on the London Midland region railway route. Population (1951) 40,671. Area, 6·9 sq mi. It lies in a deep valley on the Hindburn, a feeder of the Calder.

Accrington (Akerenton, Alkerington, Akerington) was granted by Henry de Lacy to Hugh, son of Leofwine, in Henry II's reign, but came again into the hands of the Lacys, and was given by them (*c.* 1200) to the monks of Kirkstall, who converted it into a grange. It returned to the Lacys in 1287, was granted in parcels and, like their other lands, became merged in the duchy of Lancaster. In 1836 Old and New Accrington were merely straggling villages with about 5,000 inhabitants. By 1861 the population had grown to 17,688 because of the railway junction, and it increased with the rapid development of the Lancashire coal field. Cotton spinning and printing works, cotton-mill machinery works, dye works, collieries and transport work employ the people. A girls' high school was opened in 1939. The Church of St. James dates from 1763. The original chapel was probably an oratory which was an offshoot of Kirkstall abbey. Ecclesiastically, Accrington was dependent on Altham till after the middle of the 19th century. The town was incorporated in 1878. Together with the urban districts of Church, Clayton-le-Moors and Oswaldtwistle, Accrington returns one member to parliament.

**ACCRUED DIVIDENDS,** the amount of the dividend on a stock which may be presumed to have been earned during the period between the last dividend payment and a later stipulated date. Of course such an accrual of dividend is a mere presumption since dividends are necessarily uncertain until, at the end of a dividend period, it has been ascertained that there is a surplus from which to pay one, and it has been duly declared. It is quite unusual to sell stock for a certain price plus accrued dividends, although in the cases of stock with dividend guaranteed (*see* STOCK) or in cases of preferred stock of companies in which the dividend is practically certain, it is sometimes done. Stocks are not sold with accrued dividend on organized exchanges, although it is the common custom to sell bonds with accrued interest

(*q.v.*) The term accrued dividend must not be understood to carry intimation that dividends are in arrears (*q.v.*), that idea being conveyed by the expression cumulated dividend or accumulated dividend (*q.v.*) (*See* DIVIDENDS.) (J. H. B.)

**ACCRUED EXPENSES.** Some business costs are of a continuous nature, such as wages, interest, rent, etc. The accountant records in a summary entry (usually at the close of a period) the cumulative effect of these transactions for the relevant period. The debit may be to an expense account or, if the cost is to be capitalized as an element of inventory or fixed asset, to an asset account. The credit is usually to a liability, the resulting wages payable, etc., is referred to as an accrued expense payable and appears on the statement of financial position. In a larger sense, all costs accrue, and those which are incurred in earning the revenue of a period are allocated to that period as expenses. (P. KR.)

**ACCRUED INCOME,** or ACCRUED REVENUE. Certain business transactions are of a continuous nature, such as the earning of interest or of rent. The accountant records in a summary entry (usually at the close of a period) the cumulative effect of these transactions for the relevant period, usually by a debit to a receivable and a credit to a revenue account. The resulting interest receivable, etc., is referred to as accrued income or accrued revenue receivable. It appears on the statement of financial position. In a larger sense we say that all revenues from sales of goods and services accrue and are recorded during the accounting period. (P. KR.)

**ACCRUED INTEREST,** the amount of interest on a bond which has been earned over the period from the date of the last interest payment to some specified date, but which will not be paid by the issuer of the bond until the next regular interest date. Bonds are almost invariably sold at a certain price plus accrued interest. Thus if the interest dates on a certain bond are Feb. 1 and Aug. 1, and the bond is sold on May 1, the buyer will pay the seller the stipulated price plus the interest for the three months during which the seller's money has been invested in the bond, and on Aug. 1 he will receive from the issuing corporation the full six months' interest for the period from Feb. 1 to Aug 1. Half of this interest will repay the buyer for the accrued interest which he paid to the seller, and the other half will be the interest for the three months during which his own money was invested in the bond. By specific agreement or notification bonds may be sold "flat"; *i.e.*, without considering any accrued interest. Defaulted bonds and income bonds are usually sold flat since the interest to be received from them, if any, is always problematical. (J. H. B.)

**ACCUMULATED DIVIDEND,** dividend on cumulative stock which was due but was not paid during one or more previous dividend periods. Such unpaid back dividends accumulate and it is essential that they be paid in full before any dividend can legally be paid on the common stock. (*See* CUMULATIVE PREFERENCE SHARE; DIVIDENDS.)

**ACCUMULATION,** in law, the continuous adding of the interest of a fund to the principal, for the benefit of some person or persons in the future. Previous to 1800 this accumulation of property was not forbidden by English law, provided the period during which it was to accumulate did not exceed that forbidden by the law against perpetuities; viz., the period of a life or lives in being, and 21 years afterward. In 1800, however, the law was amended in consequence of the eccentric will of Peter Thellusson (1737–97), an English merchant, who directed the income of his property, consisting of real estate of the annual value of about £5,000 and personal estate amounting to more than £600,000, to be accumulated during the lives of his children, grandchildren and great-grandchildren, living at the time of his death, and the survivor of them. The bequest was held valid (*Thellusson* v. *Woodford*, 1798, 4 Vesey, 237).

To prevent such a disposition of property in the future, the Accumulations act, 1800 (known also as the Thellusson act) was passed, by which (as altered and re-enacted by the Law of Property act, 1925) it was enacted that no property should be accumulated for any longer term than either (1) the life of the grantor or settlor; or (2) the term of 21 years from his death; or (3) during the minority of any person living or *en ventre de sa mère* at the time of his death; or (4) during the minority of any person who, if of full age, would be entitled to the income directed to be accumulated. The act does not extend to any provision for payment of the debts of the grantor or of any other person, nor to any provision for raising portions for the children or remoter issue of the settlor, or any person interested under the settlement, nor to any direction touching the produce of timber or wood. It does not apply to property in Ireland. The act has been amended by the Accumulations act, 1892, which forbids accumulations for the purpose of the purchase of land for any longer period than during the minority of any person or persons who, if of full age, would be entitled to receive the income. The Accumulations act, 1800, was applied to heritable property in Scotland by the Entail Amendment act, 1848, and the saving clause as to provision for payment of debts was disapplied to Scotland by the Entail act, 1914. Accumulations act, 1892, applies to Scotland. (*See* TRUST AND TRUSTEES.)

**ACCUMULATIVE STOCK:** see CUMULATIVE PREFERENCE SHARE.

**ACCURSIUS** (Ital. ACCORSO), **FRANCISCUS** (1182–1260), Italian jurist, was born at Florence about 1182. A pupil of Azo, he first practised law in his native city, and was afterward appointed professor at Bologna, where he had great success as a teacher. He undertook the great work of arranging into one body the almost innumerable comments and remarks upon the Code, the Institutes and Digests, the confused dispersion of which among the works of different writers caused much obscurity and contradiction.

This compilation, bearing the title *Glossa ordinaria* or *magistralis*, but usually known as the Great Gloss, though written in barbarous Latin, has more method than that of any preceding writer on the subject. The best edition of it is that of Denis Godefroi (1549–1621), published at Lyons in 1589, in 6 vol. folio. When Accursius was employed in this work, it is said that, hearing of a similar one proposed and begun by Odofred, another lawyer of Bologna, he feigned indisposition, interrupted his public lectures and shut himself up, till with the utmost expedition he had accomplished his design.

Accursius was greatly extolled by the lawyers of his own and the immediately succeeding age, and he was even called the idol of jurisconsults, but those of later times formed a much lower estimate of his merits. There can be no doubt that he disentangled the sense of many laws with much skill, but it is equally undeniable that his ignorance of history and antiquities often led him into absurdities, and was the cause of many defects in his explanations and commentaries. He died at Bologna in 1260. His eldest son Franciscus (1225–93), who also filled the chair of law at Bologna, was invited to Oxford by King Edward I, and in 1275 or 1276 read lectures on law in the university.

**ACCUSATION,** a legal term signifying the charging of another with wrong-doing, criminal or otherwise. For the accusation of another of a crime or of misconduct for the purpose of extortion, *see* BLACKMAIL.

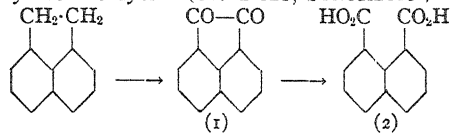
**ACCUSATIVE,** a case of the noun, denoting primarily the object of verbal action or the destination of motion.

**ACE,** the number one at dice, or the single point on a die or card; also a point in the score of racquets, lawn tennis, tennis and other court games. From its conventional use as the highest in a suit in card games, the word came to be used during World War I to signify an aeroplane pilot of supreme skill and daring.

**ACELDAMA** (AKELDAMA, R. V.), land (originally a potter's field) said in Matthew to have been bought by the priests for a burial ground for strangers with the money which was returned by Judas and could not be put into the treasury "because it was the price of blood." Aramaic חקל דמא, "the field of blood," Acts i, 19; *cf.* Matt. xxvii, 8. Acts ascribes its purchase to Judas himself, perhaps by mere compression. Manuscript authority gives AKELDAMACH (Ἀκελδαμάχ, Westcott and Hort) "the field of thy blood," which is unsuitable. Klostermann's suggestion, *Probleme im Apostletexte* (1883, pp. 1–8), "the field of sleep" (*dmak*, "he

slept," used especially of sleep in death, *e.g.*, Targum of Job, iii, 12, Syr.: *dmaka*, "sleep") is very attractive, suggesting "cemetery," and although there is no other example of such a Jewish title the figure is old (Dan xii, 2). If so, Akeldama will be only the popular, perhaps Christian, nickname In any case Acts i, 19 can hardly be as early as St. Peter's speech in which it is incorporated. No plausible explanation is given for "ch" being added to Akeldama, and there is only one exactly parallel case, the mysterious *Sirach* for *Sira* (Ecclus. L, 27 [29]) Tradition from the 4th century places the plot on the Hill of Evil Counsel—"a little level plot overhanging the valley of Hinnom." . . . The potters probably "had here a cave in which their work was carried on." (*See* Schick, P E F Q. 1892, pp 283–289.) (A L. W)

**ACENAPHTHENE**, an aromatic hydrocarbon first isolated from coal tar by M. P. E. Berthelot and subsequently synthesized from α-ethylnaphthalene. Crystallizing from alcohol in colourless needles, it melts at 95° C. and boils at 278°. Its formula is $C_{12}H_{10}$. On oxidation with chromic acid it yields (1) acenaphthenequinone employed in the manufacture of ciba scarlet and other red vat dyes; (2) naphthalic acid, a starting point in the production of certain perylene vat dyes (*See* Dyes, Synthetic)




Acenaphthene, which readily undergoes nitration and sulphonation, forms a characteristic orange picrate melting at 161°.

*See* A E Everest, *The Higher Hydrocarbons* (1927).

(G T. M)

**ACEPHALI** (ἀκέφαλοι) a term applied to sects having no head or leader; and in particular to a strict Monophysite sect that separated itself, in the end of the 5th century, from the rule of the patriarch of Alexandria (Peter Mongus) and remained "without king or bishop" till it was reconciled by Mark I (799–819) (Gr. ἀ privative, and κεφαλή, head).

The term was also used to denote *clerici vagrantes; i.e.*, clergy without title or benefice (*cf.* Hinschius, i, p. 64).

Certain persons during the reign of King Henry I were called *Acephali* because they had no lands by virtue of which they could acknowledge a superior lord. The name was also given to certain legendary races described by ancient naturalists and geographers as having no heads, their mouths and eyes being in their breasts, generally identified with Pliny's Blemmyae.

*See* Gibbon, ch. xlvii (vol v, p. 129 in Bury's ed.).

**ACERACEAE**, a natural family of dicotyledonous plants allied to the Sapindaceae, consisting of 2 genera and about 125 species, all but 2 belonging in the genus *Acer*. This genus consists of trees always with opposite and mostly simple and usually lobed or toothed, rarely entire leaves, the characteristic fruits consisting of paired, winged, one-sided carpels, a typical samara. The genus *Acer* is mostly confined to the north temperate zone and is highly developed in species in North America and in temperate and subtemperate Asia. For a monographic treatment, *see* F Pax, *Aceraceae*, Pflanzenreich 8 (iv, 163), 1–89, fig. 1–14 (1902). *See* Maple. (E. D. Ml.)

**ACERENZA** (anc. *Acheruntia*), town in province of Potenza, Italy, the seat of an archbishop, 15½ mi. N.E. of the station of Pietragalla, which is 9 mi. N.W. of Potenza by rail, 2,730 ft. above sea level. Pop. (1936) 4,625 (town), 4,788 (commune).

**ACERRA**, town and episcopal see, province of Naples, Italy, 9 mi N E. from Naples. Pop. (1936) 19,177 (town), 21,937 (commune). The town lies on the right bank of the river Agno, 90 ft. above sea level, in a fertile but somewhat marshy district which in the middle ages was very malarious. The ancient name (*Acerrae*) was also borne by a town in Umbria and another in Gallia Transpadana (the latter modern Pizzighettone on the Adda, 13 mi. W.N.W. of Cremona). It became a city with Latin rights in 332 B.C., and later a *municipium*. It was destroyed by Hannibal in 216 B.C., but restored in 210; in 90 B.C. it served as the Roman headquarters in the Social War, and was successfully held against the insurgents. It received a colony under Augustus, but appears to have suffered much from floods of the river Clanis Under the empire no more is heard of it, and no traces of antiquity, beyond inscriptions, remain

**ACERRA**, in Roman antiquity, a small box or pot for holding incense, as distinct from the turibulum (thurible) or censer in which incense was burned The name was also given by the Romans to a little altar placed near the dead, on which incense was offered every day till the burial. In ecclesiastical Latin the term acerra is still applied to the incense boats used in the Roman ritual

**ACETABULUM**, the Latin word for a vinegar cup, an ancient Roman vessel, used as a liquid measure (equal to about half a gill), it also became used technically in zoology, by analogy for certain cup-shaped parts; *e g*, the suckers of a mollusc, the socket of the thighbone, etc.; and in botany for the receptacle of fungi

**ACETALDEHYDE** or simply aldehyde, is the second aldehyde (*q v.*) of the aliphatic series. Its molecular formula is $C_2H_4O$, and its structure is $CH_3$-CHO. It is a colourless liquid boiling at 21° C., and possessing a powerful characteristic odour. It occurs in the crude ethyl alcohol (*q v.*) obtained by the fermentation of sugars and in the crude methyl alcohol obtained by the destructive distillation of wood It is manufactured both by the oxidation of ethyl alcohol and by the hydration of acetylene (*q v.*) It is transformed by reduction into ethyl alcohol and by oxidation into acetic acid (*q.v.*).

**ACETAMIDE:** *see* Amides.

**ACETANILID**, also called antifebrin, made by interaction of glacial acetic acid with aniline (*q v.*). It is a febrifuge or antipyretic, used in headaches and fevers, of which it reduces the pain without removing cause. It may cause aniline poisoning, a depressant action on the heart muscle, resulting in collapse, nausea, vomiting and a blueness of lips and nails. The last is caused by chemical changes in the blood, whereby red corpuscles lose their power to carry oxygen.

Acetanilid is a white, crystalline substance melting at 115° C, boiling at 305° C and soluble in water, alcohol or ether. Its chemical formula is $C_6H_5.NH.CO.CH_3$.

**ACETATES:** *see* Acetic Acid.

**ACETIC ACID**, the organic acid which gives to vinegar (from which it derives its name) its characteristic sharp taste, is the second of the series of aliphatic acids, formic acid (*q.v.*) being the first.

Its formula is $CH_3\,CO_2H$, and it occurs in nature in plant juices occasionally as free acid but more generally as calcium or potassium salts.

Three processes are available for large-scale production of acetic acid, $CH_3.COOH$.

**1. Fermentation Processes.**—Several species of bacterium convert dilute alcoholic liquors into impure acetic acid in the form ordinarily known as vinegar. This bacterial fermentation, which takes place in the presence of air and a certain amount of nutrient phosphates and nitrogenous material necessary for the feeding of the bacteria, involves the oxidation of ethyl alcohol (*see* Alcohol) into dilute acetic acid. A more concentrated acid is obtainable by neutralizing the dilute acid with lime to form calcium acetate and then distilling a mixture of this salt with concentrated sulphuric acid.

Except for the manufacture of vinegar, the fermentation process is no longer an important factor in the industrial preparation of acetic acid.

In the oxidation of alcohol to acetic acid the living acetic bacteria may be replaced by specific enzymes (unorganized ferments) or even by spongy platinum or palladium since either of these, in the presence of air, oxidizes the alcohol first to acetaldehyde and then to acetic acid.

**2. Destructive Distillation of Wood.**—A relatively small proportion of the acetic acid of commerce is now obtained by the destructive distillation of wood, the hard woods yielding 4.7% to 6.5% of the concentrated acid.

**3. Synthetic Acetic Acid.**—The starting point in the industrial synthesis of acetic acid is calcium carbide made in the electric

furnace from limestone and coal. The acetylene evolved from the carbide by addition of water is converted into acetaldehyde by passing into hot dilute sulphuric acid containing mercuric sulphate. The acetaldehyde is further oxidized by air or oxygen in the presence of a catalyst consisting of the oxides of metals such as iron, vanadium and uranium, acetic acid being thereby formed.

In 1950 about 220,000 tons of synthetic acetic acid were made in the United States.

Anhydrous acetic acid, usually termed glacial acetic acid owing to its icelike crystallization at 16.7° C., has a very pungent odour and boils at 118° C. to a heavy inflammable vapour. Its alkali salts are soluble in water. Ferrous and ferric acetate are used as mordants in dyeing (*q.v.*). Normal lead acetate is known in commerce as sugar of lead and basic copper acetates are known as verdigris (*q.v.*).

Acetic acid and the acetates are detected by heating with ethyl alcohol and sulphuric acid; ethyl acetate is evolved and recognized by its fragrant odour. When heated with arsenious oxide, acetates give rise to the malodorous and highly poisonous cacodyl oxide.

**Pharmacology and Therapeutics.**—Glacial acetic acid is sometimes used as a caustic for corns The soluble acetates, and especially potassium acetate, are used mainly as alkaline diuretics and to counteract acidosis. After absorption in the blood, they are oxidized to carbonates, increasing the alkalinity of the blood or reducing the acidity of the urine without the disturbing influence of alkalis on the digestive tract.

**ACETOACETIC ESTER,** ethyl acetoacetate is an outstanding example of a chemical substance having a dual character arising from the possession of two different molecular structures. Such substances are called tautomeric compounds (*see* ISOMERISM). The substance is an ester (which see), and has the molecular formula $C_6H_{10}O_3$. The two tautomeric forms are represented by

$$CH_3.CO.CH_2.CO.OC_2H_5 \text{ (ketonic form) and}$$
$$CH_3C(OH):CH.CO_2C_2H_5 \text{ (enolic form),}$$

and ordinary specimens of the ester as handled in commerce may be regarded as consisting of 93% of the former in equilibrium with 7% of the latter. When treated by reagents which combine with ketones, such as sodium bisulphite, hydroxylamine, phenylhydrazine and hydrocyanic acid, the ketonic character of the ester is manifested, and when acted upon by reagents such as phosphorus pentachloride, diazomethane, ammonia and amines, which detect alcoholic (enolic) groups, then its enolic nature is revealed.

In 1911 L. Knorr separated the two forms of the ester in a state of purity. The ketonic modification was frozen out of the equilibrium mixture at −78° C. and the enolic modification was isolated in the liquid condition by decomposing the sodium derivative with hydrogen chloride at the same low temperature. In these experiments it was found to be essential to use silica vessels. The ester was first discovered by A. Geuther in 1863. The original method of production is still employed on a manufacturing scale. Sodium, either molten or in wire form, is added to dry ethyl acetate containing a little ethyl alcohol. When all the metal has dissolved the mixture is acidified with dilute acetic or sulphuric acid and the crude acetoacetic ester, which is partially miscible with water, separates as an oil on addition of common salt and is purified by distillation under diminished pressure. The ester is a colourless, fragrant liquid boiling, with slight decomposition, at 181° C. under a pressure of 760 mm.

The sodium condensation requires the presence of a small amount of alcohol. The role of this alcohol is made apparent by the following probable mechanism of the reaction:

i. $2C_2H_5OH + 2Na = 2C_2H_5ONa + H_2$
ii. $CH_3CO_2C_2H_5 + C_2H_5ONa = CH_2:C(ONa)OC_2H_5 + C_2H_5OH$
iii. $CH_2:C(ONa)OC_2H_5 + CH_3CO_2C_2H_5 =$
$CH_3C(ONa):CH.CO_2C_2H_5 + C_2H_5OH$

In the chemical laboratory acetoacetic ester is a valuable synthetic reagent, for its sodium derivative when acted on by an alkyl iodide yields an alkylacetoacetic ester, and the sodium derivative of the latter ester by similar means furnishes a dialkylacetoacetic ester. These alkyl- and dialkyl-acetoacetic esters may be employed in producing either higher ketones or higher fatty acids.

The ester has also been employed in the synthesis of pyridines (*q.v.*), quinolines (*q.v.*), furans (*q.v.*), pyrazoles (*q.v.*), pyrroles (*q.v.*), and compounds of the purine (*q.v.*) group.

In addition to the foregoing scientific uses acetoacetic ester is utilized industrially in the manufacture of synthetic drugs and dyes. Of these drugs the best known is antipyrine (*q.v.*) which is prepared by methylating phenylmethylpyrazolone, the condensation product of acetoacetic ester and phenylhydrazine.

Several important dyes belong to the pyrazolone series. Eriochrome red (Chrome fast red B) is manufactured by successively condensing acetoacetic ester with phenylhydrazine and with diazotized 1-amino-β-naphthol-4-sulphonic acid. A series of yellow dyes and pigment colours is similarly produced by condensing the ester successively with various aromatic hydrazines and diazo-compounds (*see* DYES, SYNTHETIC).

**ACETONE** is present in very small quantities in normal urine, in the blood, and in larger quantities in diabetic patients, and is the simplest representative of the aliphatic ketones. It results with other ketones from the destructive distillation of wood and other cellulosic derivatives, and for this reason it is present in crude wood spirit (methyl alcohol). It has the formula $CH_3\,CO\,CH_3$ and is thus dimethyl ketone. Acetone is a colourless, fragrant, inflammable, mobile liquid, boiling at 56.3° C. and miscible in all proportions with water, alcohol and ether. It has very useful solvent properties, dissolving considerable quantities of acetylene gas (*q.v.*). It dissolves many fats and resins and is a solvent for cellulose nitrate and acetate. On account of the latter properties, it finds extensive use in the manufacture of cordite and of artificial silk.

On account of its valuable properties as a solvent and as an organic reagent, acetone is prepared on a large scale, the processes available being as follows:—

1. The dry distillation of calcium acetate leading to the formation of acetone and calcium carbonate.
2. The catalytic (*see* CATALYSIS) decomposition of glacial acetic acid into acetone, carbon dioxide, and water when it is passed over heated metallic oxides such as alumina and thoria.
3. The fermentation of maize, rice, horse chestnut meal or other starchy materials with a bacterium discovered by A. Fernbach, the starch present being converted into a mixture of normal butyl alcohol (6 parts), acetone (3 parts) and ethyl alcohol (1 part).
4. The dehydrogenation or oxidation by air of isopropyl alcohol in the presence of heated metallic or metal oxide catalysts.

Acetone is employed in many organic syntheses. Dehydrating agents convert it successively into mesityl oxide and phorone, and on distillation with sulphuric acid it is transformed by elimination of water into mesitylene (1:3:5-trimethylbenzene). In conjunction with *ortho*nitrobenzaldehyde, it has been used to prepare synthetic indigo.

*Therapeutic Applications.*—The ketones in general give rise to narcosis and lowering of blood pressure and acetone itself produces intoxication and sleep but is less powerful than ether or chloroform, although less toxic than ethyl alcohol. When treated with chlorine, bromine, or iodine in presence of alkali, acetone is converted respectively into chloroform, bromoform, or iodoform. It is the starting point in the production of the narcotic drug sulphonal.

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**ACETOPHENONE** or phenyl methyl ketone is the simplest representative of the mixed aliphatic-aromatic ketones. It crystallizes in colourless leaflets with a characteristic odour; it melts at 20° C. and boils at 202° C., is volatile in steam and has the composition, $C_6H_5.CO.CH_3$. It occurs to a small extent in coal tar and, having feebly basic properties, is extracted from the heavy oil fractions (b.p. 160–190°) with sulphuric acid.

Acetophenone condenses with phenylhydrazine but does not combine with sodium hydrogen sulphite. It results from the distillation of a mixture of dry calcium acetate and benzoate but is best prepared by condensing benzene and acetyl chloride with aluminium or ferric chloride in carbon disulphide. It has anaesthetic and soporific properties and under the name of hypnone has been used as a drug to induce sleep. With hydroxylamine it condenses to acetophenoneoxime, $C_6H_5C(CH_3):NOH$, which, under the influence of phosphorus pentachloride in ether is converted into the isomeric acetanilide, $C_6H_5NH.CO\,CH_3$, this transformation being an example of the so-called Beckmann change which occurs with ketone oximes in general. *p*-Aminoacetophenone also has anaesthetic properties, whereas the condensation product of acetophenone and phenetidine is an antipyretic substance. On adding sodium to acetophenone dissolved in ethyl acetate the sodium derivative of benzoylacetone is produced from which benzoylacetone, $C_6H_5CO.CH_2CO\,CH_3$ is obtained by acidification, this condensation being a typical example of the Claisen reaction.

**ACETYLENE** is a colourless gaseous compound of 7.74% of hydrogen and 92.24% of carbon, used as a fuel both in the oxy acetylene process for the welding and cutting of metals and also for isolated or independent lights. It is the simplest of all unsaturated organic compounds and has the composition HC CH (*see* CHEMISTRY: *Organic*). It changes to a colourless transparent liquid under a pressure of 61.6 atmospheres at the critical temperature of 36.5°C. At a pressure slightly above 1 atmosphere and below −81.8°C. the liquid contracts and [illegible] crystals melt at −81.8°C. at a pressure above 1 atmosphere and sublime at −83.6°C. at 1 atmosphere.

Acetylene is an endothermic compound, which means that heat is absorbed in its formation from carbon and hydrogen and that it can decompose to the elements with liberation of heat. For this reason liquid and solid acetylene and gaseous acetylene at a pressure above about 2 atmospheres are violently explosive when subject to shock, spark or sudden heating even in the absence of oxygen. The sale or transportation of acetylene in these forms is generally prohibited.

The density of gaseous acetylene is 0.9056 (air = 1) and its mean coefficient of expansion between 0°C. and 100°C. is 0.003738 (air is 0.003671). Because it has a greater density and a higher energy content than other common fuel gases it gives a greater heating or lighting effect. The density of liquid acetylene is 0.613 at −80°C. and its coefficient of expansion is 0.0024.

Acetylene is very soluble in certain liquids which contain oxygen or nitrogen and do not contain acidic hydrogen; in other classes of liquids the solubility is much lower. This behaviour has been attributed to an electrostatic attraction between a hydrogen atom in acetylene and an atom of oxygen or nitrogen in the solvent. The approximate number of volumes of acetylene (calculated at 25°C.) soluble in 1 volume of some typical liquids at 1 atmosphere is as follows:

| *Solvent* | *Volumes* | *Temp. °C.* | *Solvent* | *Volumes* | *Temp. °C.* |
|---|---|---|---|---|---|
| Acetaldehyde | 60 | −10 | Benzene | 4 | 20 |
| Methyl acetate | 52 | −10 | Paraffin oil | 1.5 | 20 |
| Dimethyl formamide | 37 | 20 | Acetic acid | 6 | 20 |
| Acetone | 18 | 18 | Ethyl alcohol | 6 | 20 |
| Dioxane | 16 | 25 | Water | 1.15 | 15 |

The solubility of acetylene in all solvents increases with decreasing temperature and increasing pressure. The solubility is of interest because acetylene must be stored and transported as a solution under pressure (*see* below) and because it is possible to use selective solvents for the separation of acetylene from industrial mixed gases (*see* below). Since the solubility of acetylene in water at moderate pressure is limited, water and aqueous solutions can be used as washing or confining liquids in generating plants and gas holders.

**Acetylene from Calcium Carbide.**—In 1945 nearly all acetylene was made from calcium carbide, a compound of calcium and carbon, having the formula $CaC_2$ and therefore containing in its pure state 37.47% carbon. It interacts with water immediately on contact, yielding acetylene and slaked lime: $CaC_2+H_2O\rightarrow Ca(OH)_2+C_2H_2$. Commercial calcium carbide contains about 20% of inert material and ordinarily yields 4.80 cu.ft. of moist acetylene per lb. at 60°F. and 30 in. pressure or the equivalent figure, 300 litres of moist acetylene per kg. at 15° C. and 760 mm. A good grade of calcium carbide has a specific gravity of 2.22 and resembles fine-grained granite or hard limestone in appearance and hardness. The commercial product is broken and screened to lumps of convenient size for different uses, and is packed for transport in air tight steel drums. Since it evolves acetylene slowly when exposed to damp air and rapidly when wetted, calcium carbide is everywhere subject to special regulations for transport and storage.

The industrial production of calcium carbide was initiated in 1892 by T. L. Wilson, a Canadian electrical engineer at Spray, N.C. Its manufacture is conducted on a large scale in most localities where water power is available at low cost, notably in Norway and Sweden, Shawinigan (Quebec) and Niagara. It is made by heating together in the electric furnace a mixture of lime with about 40% of coke or anthracite. The reaction begins at the solid contact surface of lime with carbon and attains an appreciable rate at about 1,700°C., the melting point of a eutectic of lime with calcium carbide in the presence of ordinary impurities. After the reaction is initiated it occurs chiefly between the fused lime in the eutectic and solid carbon. Carbon monoxide is evolved and in modern furnaces is collected as a by-product. The reaction is $CaO+3C\rightarrow CaC_2+CO$. The melting point of the flux of lime and calcium carbide rises until 52% of calcium carbide accumulates, then falls until the mixture containing 68% calcium carbide melts at 1,750°C. or lower, and then again rises towards the melting point of pure calcium carbide, estimated at about 2,300°C. As the temperature approaches this point a decomposition of calcium carbide to calcium and carbon sets in, and this constitutes a limiting factor, which prevents the formation of pure calcium carbide in this way. In the United States, it has been found most economical to stop the operation when the calcium carbide content reaches 78–80%.

Acetylene is obtained by bringing calcium carbide into contact with water, and innumerable forms of generators have been devised with the object of effecting and controlling the reaction so that acetylene shall be liberated at the desired rate. The reaction is one in which heat is set free, about 166 B.T.U. being released for each cu.ft. of acetylene formed. This heat of reaction may produce localized temperatures high enough to cause polymerization (*q.v.*) of part of the acetylene or even to decompose it to carbon and hydrogen, unless overheating is prevented by the use of excess water. In small generators water commonly drips on the carbide at a rate controlled by a hand-operated valve or by the restriction of the free egress of the evolved gas. In large generators, however, the carbide is either dropped into a large excess of water, or is intermittently submerged by a local excess of water. Provision should be made for the sludge of slaked lime, which is the residue of the decomposition of carbide, to settle down out of close contact with the carbide which has already been decomposed. The sludge is, in most instances, withdrawn at intervals in a semifluid condition. This sludge of calcium hydroxide has little value, and, since about 1935, methods using a minimum of water and yielding a dry powdered calcium hydroxide have received increasing attention. In generators of this type the heat of reaction is used in converting a part of the water into steam, which is later condensed out of the acetylene. It is important that generators liable to be recharged at short intervals be so constructed that air cannot enter the heated interior during discharging and recharging, both because of the danger of ignition and because air is an undesirable impurity in acetylene for some uses.

Acetylene from calcium carbide contains characteristic impurities. Nitrogen, arsenic, sulphur and silicon occur as calcium compounds in carbide, and on treatment with water these yield the corresponding hydrides: ammonia, phosphine, arsine, hydrogen sulphide and silicane. Acetylene generated from modern carbide usually contains less than 0.015% of ammonia, 0.015–0.025% of phosphine, less than 0.01% of hydrogen sulphide, and less than 0.0003% of arsine. At the high temperatures that sometimes

occur in acetylene generators, these simple hydrides may combine with acetylene to yield organic impurities, *e.g.*, divinyl sulphide has been identified as an impurity in acetylene from calcium carbide. High temperatures may also result in the formation of benzene and other aromatic hydrocarbons from acetylene. The crude acetylene from the generator also contains moisture, finely divided solids, air, and sometimes traces of hydrogen and simple aliphatic hydrocarbons. These impurities are minimized in modern practice by selection of suitable materials for carbide manufacture and by careful control of acetylene generation, but some purification of the gas is necessary.

In large acetylene plants the gas may be dried by refrigeration, or by the use of aluminum oxide, or by washing with a solution of calcium chloride. The removal of the phosphine and some of the other hydride impurities is accomplished by oxidation with 85% sulphuric acid or by Granjon's material, a mixture of ferric chloride, ferric oxide, manganese dioxide, mercuric chloride and cupric sulphate. Commercial purifying materials, containing chromic acid or hypochlorites have also been used for this purpose. When the removal of oxygen from acetylene is essential, an aqueous alkaline solution of sodium hydrosulphite containing a small quantity of anthraquinone beta sulphonic acid is employed as a washing liquid. The total removal of all impurities has been accomplished only by liquefaction and distillation of acetylene, and this is considered too hazardous for commercial application. Pure acetylene is a rare laboratory chemical.

Carbides of the other alkali and alkaline earth metals also yield acetylene, but they have disadvantages which debar them from industrial production and use.

**Acetylene from Other Hydrocarbons.**—M. Berthelot in 1862 first identified and named acetylene as a product of the pyrolysis, or thermal decomposition, of other organic compounds. This was the basis of an old laboratory method for the preparation of acetylene, but the method was neglected until petroleum, natural gas, and coke-oven gas became abundant and cheap enough to make the process economically attractive. In Germany during 1940–45 some acetylene was made from gases containing methane. In the United States little acetylene has actually been produced by this method but much research has been done on the manufacture of acetylene from natural gas or from petroleum fractions which are least valuable for other purposes. The method consists of heating an organic compound, usually a gaseous or liquid hydrocarbon, to a temperature of 1,300–1,700° C. for a fraction of a second, cooling the resulting gas mixture below 400° C. with extreme rapidity, and separating the acetylene from the other gaseous products. The heating may be accomplished by an electric discharge, by partial combustion of the raw material or by contact with a heated surface. It must be of very short duration because acetylene decomposes to carbon and hydrogen, with which it is in equilibrium in this temperature range. The rapid cooling is usually accomplished by expansion and is essential to prevent conversion of acetylene to aromatic hydrocarbons, which occurs over most of the cooling range. The power consumption in the manufacture of acetylene by pyrolysis, even with electrical heating, is estimated to be somewhat less than in the production of acetylene from carbide.

Acetylene commonly comprises about 5–25% of the mixed gases produced by this method, and its separation is the most expensive step in the process. The small proportion of hydrocarbons containing four or more carbon atoms can be removed by refrigeration or extracted by cold solvents. Traces of more reactive hydrocarbons such as butadiene, methyl acetylene, diacetylene and some olefins can be removed by reaction with sulphuric or phosphoric acid or aluminum chloride. Small quantities of acidic impurities such as hydrogen sulphide, hydrogen cyanide and carbon dioxide can be eliminated by an alkaline wash. Acetylene then is usually extracted by a selective solvent from the remaining mixture containing methane, ethane, ethylene and much hydrogen. A number of good solvents for acetylene have been proposed for this use, but most of them dissolve an undesirably high proportion of ethylene. In Germany water has been used as a solvent to extract acetylene from a gas mixture under a pressure of about 20 atmospheres. Water is especially effective for the separation of acetylene from ethylene at high pressures because of the comparatively low solubility of ethylene. The solubility of acetylene in water increases approximately in proportion to the partial pressure of acetylene up to 5 atmospheres and to a slightly lesser extent at still higher pressures. Further research on the pyrolytic method and the recovery of acetylene from mixed gases may make this procedure a serious competitor of the carbide process.

**Dissolved Acetylene.**—The relatively large solubility of acetylene in acetone was first observed by G. Claude and A. Hess in 1897 who stated in the *Compies Rendus* of that year that the solubility was also very nearly proportional to the pressure, being about 300 volumes at a pressure of 12 atmospheres. They pointed out that the coefficient of expansion of the solution in acetone was very much lower than that of liquid acetylene and, moreover, that the solution did not explode when a wire in it was raised to bright redness. Their observations led ultimately to the development of the present method of supplying acetylene in portable steel cylinders in which it is safely stored under pressure as a solution in acetone. Acetone increases in volume by 4.4% for each atmosphere pressure at which it is saturated with acetylene. Consequently acetone in which acetylene is dissolved under an absolute pressure of 16 atmospheres occupies $1+(16\times0.044)$ times its original volume. This pressure was that to which steel cylinders packed with porous material were permitted by law to be charged with acetylene in Great Britain, and the strength and construction of the cylinders was also specified by law. Similar regulations were enforced in other countries. Since the volume of the acetone solution varies with the amount of acetylene dissolved, it is obvious that the cylinders in use must be only partially filled with the liquid, the remaining space being occupied by compressed gaseous acetylene. Such compressed free acetylene would be liable to explode if the cylinder were exposed to great heat or shock but this risk is avoided by first filling the cylinder with inert porous material the interstices in which will be sufficiently small to prevent any explosion from spreading beyond the point at which it is initiated. Various porous materials have been used for this purpose, *e.g.*, dried clay, [illegible] brick, infusorial earth, kieselguhr and charcoal, singly or [illegible] with or without a binder. The porous material generally preferred is the vegetable fibre kapok, the resilient properties of which cause it to be evenly distributed and free from large open spaces. Current practice in 1945 in Great Britain was to pack the cylinder uniformly with kapok until the solid matter of the latter occupied one-fifth of the capacity of the cylinder, thus leaving four-fifths as interstices in the kapok packing. The acetone is run in to fill a further two-fifths, leaving two-fifths of the internal volume of the cylinder for expansion of the acetone on charging with acetylene and any subsequent exposure to heat. Cylinders of dissolved acetylene thus prepared are convenient and safe. Several proposals and patents for substituting other solvents for acetone in acetylene cylinders had not been applied commercially up to 1945.

**Fuel Uses.**—Acetylene requires 2.5 times its volume of oxygen or 11.95 times its volume of air to effect its complete combustion. It is used for lights in portable lamps, buoys, road signals, isolated premises, etc., but the consumption of acetylene for lighting is small compared to its use in the industrial welding and cutting of metals, for which purposes it is consumed in a blowpipe to which a supply of undiluted oxygen is given from a steel cylinder containing that gas under pressure. In welding, a reducing flame is maintained by using less than the proportion of oxygen required for complete combustion, whereas in cutting metals an excess of oxygen is admitted to oxidize the metal. Since acetylene is an endothermic compound its heat of combustion is greater than that of the constituent carbon and hydrogen. On this account acetylene affords a higher flame temperature than other fuel gases, above 3,000° C. in a correctly designed and operated torch.

**Chemical Uses.**—The simple composition, availability and reactivity of acetylene make it a suitable starting material for the industrial synthesis of several other organic compounds.

Acetaldehyde has been manufactured at Shawinigan, Que., Can ,

and in central Europe since about 1917 by the chemical combination of water with acetylene in the presence of sulphuric acid and mercuric sulphate as catalysts. Much of the acetaldehyde is oxidized to produce acetic acid. Sodium acetate has been made by the Dow Chemical company at Midland, Mich., by the reaction of acetylene on a concentrated aqueous solution of sodium hydroxide with liberation of hydrogen gas. A somewhat related reaction is the formation of acetone from acetylene and steam in the presence of certain alkaline earth on rare earth oxides or hydroxides. Several firms in Europe and the United States manufacture vinylacetate by the chemical addition of acetic acid to acetylene in the presence of a mercuric salt and sulphuric acid or a sulphonic acid. The vinylacetate is used as a constituent of synthetic resins. In a further stage of this reaction the addition of acetic acid to vinylacetate produces ethylidene diacetate. This substance is then decomposed by heating with a catalyst to yield acetaldehyde and acetic anhydride, which is required for the manufacture of cellulose acetate. The reaction of chlorine with acetylene is usually carried out in the presence of gaseous diluents or solvent liquids to prevent explosions. A number of catalysts (*e.g.,* ferric chloride) have been employed to promote the reaction. A mixture of the two possible dichloroethylenes results from the reaction of molar proportions of chlorine with acetylene. The addition of a second molar portion of chlorine yields tetrachloroethane. This substance is converted to trichloroethylene by the loss of hydrogen chloride. These chlorine derivatives of acetylene find use as industrial solvents for oily materials.

The DuPont company of Wilmington, Del., during the period 1930–35, developed a process for the production of a synthetic elastomer or rubber substitute from acetylene. The process was based on the discovery by Dr. J. A. Nieuwland that a saturated solution of cuprous chloride and ammonium chloride containing the solid salts in suspension converted acetylene to a gaseous dimer, vinyl acetylene, $HC{\equiv}C-CH=CH_2$ and a liquid trimer, divinyl acetylene, with smaller proportions of other polymers. Vinyl acetylene was found to add hydrogen chloride in the presence of cuprous chloride to produce the liquid chloroprene, which polymerized to a rubber-like substance, neoprene. This material was extensively used during 1943–46 in the manufacture of tires and tubes and other elastic articles. It is superior to rubber in resistance to heat, oxidation and disintegration by oils. In volume of acetylene consumed and value of the product this was the most important chemical use of acetylene.

A hydrogen atom of acetylene may be replaced by an atom of certain metals to form a class of substances called acetylides. Some of these compounds are useful for the laboratory preparation of compounds containing the ethynyl group, $-C{\equiv}CH$.

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(R. R. V.)

**ACETYLENE, IN MEDICINE.** Acetylene, which when pure loses its usual offensive smell, is an anaesthetic when inhaled and was first used as such in 1924. Like ethylene (*q.v.*) it is in the experimental stage at present. Its efficiency is between that of gas-oxygen and ether. It has the advantage that far greater amounts of oxygen can be given with it, up to about 50%, than with ethylene or nitrous oxide. (W. S. S.)

**ACHAEA.** (1) A district on the north coast of the Peloponnesos, between the mountains of Erymanthus and Cyllene and the Corinthian gulf; bounded on the west by Elis, east by Sicyon, sometimes included in Achaea. The 12 cities in its narrow fertile coastland formed a religious confederacy, meeting in Poseidon's sanctuary at Helicé: from this developed the political ACHAEAN LEAGUE (*q.v.*) of Hellenistic times.

(2) Achaea Phthiotis is a district S. of Thessaly (Thessalia) and W. of the Gulf of Pagasae (Vólos). For the origin of the name, and relations between north and south Achaea, *see* ACHAEANS.

(3) "Achaea" was the name given by the Romans to the province formed in 140 B.C. for the mainland of Greece south of Thessaly, Epirus and Acarnania, which were included in "Macedonia." Its administrative capital was Corinth (Kórinthos).

(4) Achaea in the middle ages was a principality, formed within the same region after the Latin conquest of the Eastern empire (A.D. 1204): the first prince being William de Champlitte (d. 1209). It survived, with various dismemberments, until 1430 when the last prince, Centurione Zaccaria, ceded the remnant to his son-in-law, Theodorus II, despot of Mistra. In 1460 it was conquered, with the rest of the Morea, by the Turks.

(5) Achaea in modern Greece is the Peloponnesian district (1), mainly engaged in currant growing, the crop being shipped from Patras (Pátrai) and Aegion (Vostitza).

**ACHAEAN LEAGUE,** a confederation of the towns of Achaea in ancient Greece. Isolated on their narrow strips of plain, these towns were exposed to the raids of pirates from the north of the Corinthian gulf. As a protection against such dangers the earliest league of 12 Achaean cities arose. In the 4th century we find it fighting in the Theban wars (368–362 B.C.), against Philip (338) and Antipater (330). Antigonus Gonatas dissolved the league; but by 280 B.C. four towns combined again, and before long the ten surviving cities of Achaea had renewed their federation. Much was due to Aratus (*see* ARATUS OF SICYON) who initiated an expansive policy; in 228 it included Arcadia, Argolis, Corinth (Kórinthos) and Aegina (Aígina).

Aratus probably also organized the new federal constitution. The league embraced city-States which maintained their internal independence and powers of self-government. Only in foreign politics and war was their competence restricted.

The central government was democratic. The legislative powers resided in a popular assembly, meeting at Aegium, in which every member of the league over 30 years of age could speak; each city counted one on a division. Extraordinary assemblies could be convoked in special emergencies. A council of 120 delegates served as a committee for preparing the assembly's programme. The chief magistracy was the *strategia* which combined with an unrestricted command in the field a large measure of civil authority and had practically the sole power of introducing measures before the assembly. The ten *demiourgoi,* who presided over this body, formed a kind of cabinet. Philopoemen (*q.v.*) transferred the seat of assembly from town to town by rotation, and placed dependent communities on an equal footing with their former suzerains.

The league prescribed uniform standards and coinage; it summoned contingents, imposed taxes and fined or coerced refractory members.

The first federal wars were against Macedonia, against Antigonus Gonatas and Aetolia and, with Aetolia, against Demetrius. A greater danger arose (227–223) from the attacks of Cleomenes III. (*q.v.*). Owing to Aratus's irresolute generalship the indolence of the burghers and the inadequacy of its troops the league lost much of its territory. The assembly negotiated with Antigonus Doson, who recovered the lost districts but retained Corinth for himself (223–221). When Philip V. came to the rescue against the Aetolians he annexed much of the Peloponnese. Under Philopoemen the league, with a reorganized army, routed the Aetolians (210) and Spartans (207, 201). After their neutrality during the Macedonian War the Roman general, T. Quintius Flamininus, restored their lost possessions, bringing the Peloponnese under Achaean control. In 150 B.C. the league, in defiance of Rome, attacked Sparta. The federal troops were routed near Corinth by L. Mummius Achaicus (146). The Romans now dissolved the league, and took measures to isolate the communities. Augustus instituted an Achaean synod comprising the dependent cities of Peloponnese and central Greece.

The chief defect of the Achaean league lay in its lack of provision for securing efficient armies and regular payment of imposts, and for dealing with disaffected members. It is the glory of the league, however, to have combined city autonomy with an organized central administration, and in this way to have postponed the entire destruction of Greek liberty for over a century. (*See* ROME: *Ancient History.*)

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*Greek History*; L. Whibley *A Companion to Greek Studies* (1916). The chief classical authorities are Polybius (esp. ii., iv., v., xxiii. and xxviii.), who is followed by Livy (xxxii., xxxv., xxxviii., etc.); Pausanias vii. 9. 24.

**ACHAEANS.** The name Achaeans is used in the Homeric poems in much the same sense as that in which the name Hellenes came to be used in later times. To Homer the Hellenes were a small tribe in Southern Thessaly (*Il.* ii. 684), but from the 8th century onwards the name became a general designation for all Greek-speaking peoples. Whether the name Achaeans was quite so general in its application is still a matter of doubt, but for practical purposes we may regard it as parallel. According to the traditional genealogies Achaeus was the son of Xuthus, son of Hellen.

The name has been connected with that of the Germanic tribe, Ingaevones, a connection that is possible but, perhaps, not very convincing. No light is thrown by it upon the meaning of the name. The Achaeans were a Greek-speaking people, but whether their dialect was Aeolic, Ionic or of the Arcadian type is a question that cannot yet be decided. The Homeric poems are in an artificial literary dialect.

The exact relationship between the Achaeans and Mycenaean culture is still a matter of doubt. The view held by Sir William Ridgeway was that the Achaeans were invaders from the north, a people of northern characteristics, of the fair-haired, grey-eyed type, bringing to Greece a civilization of Danubian origin distinguished by the use of iron, similar to the Hallstatt and Villanova cultures. The former inhabitants were, in his view, of a short, dark Mediterranean type, but Greek-speaking. It was the Achaeans who, according to this view, brought the *labialising* dialects to Greece.

The view more generally held, however, has been that the Mycenaean peoples were not Greek-speaking. The question depends to some extent upon another: What was the language spoken by the Minoan peoples of Crete, of whose culture the Mycenaean was an offshoot? There is no real evidence that the Minoans spoke Greek, or even an Indo-European language at all, and indeed there are many considerations that point to the conclusion that they did not.

A third and more recent view is that the Greek-speaking peoples came to Greece in three separate waves, Ionian, Achaean and Dorian, the first invasion occurring about the 17th century B.C. The Mycenaean civilization was an Achaean civilization, Greek-speaking, and differing in certain notable respects, for example, in dress, from the Minoan. The Greek invaders subdued a previous non-Greek population and first destroyed the Minoan civilization, afterwards reconstituting it, mingled with northern elements, their advent having much the same effect as the barbarian conquest of the Roman empire.

The facts hitherto known are these. There had existed an early population of Greece having a close connection with Anatolia. A large number of place names occur throughout the Greek mainland as well as in Macedonia, Epirus and Thrace which are paralleled in Asia Minor, notably those in *-νθος* and *=σσος*. These are generally regarded as being non-Indo-European and therefore non-Greek. The Greeks were aware of the existence of earlier inhabitants of their country and the Aegean islands, whom they called by the general name of Pelasgians (*q.v.*), distinguishing, however, Leleges and Carians, the latter of whom [illegible] south-western corner of Asia Minor in historical times.

Again, it is probable, if not certain, that the whole Peloponnese, and possibly parts of Central Greece, were inhabited by Ionians previous to their conquest by Achaeans. The traditional home of the Ionians was in the north-eastern Peloponnese, whence they were driven to Attica and the Cyclades by an Achaean invasion. The fact that the name Ionian was applied to the sea west of Greece, on whose shores no Ionians lived in historical times, nor could have done so for many centuries previously, shows that the whole Peloponnese at least must once have been regarded as Ionian. The Achaeans emerge into history in the middle of the 14th century B.C. In the year 1922 a reference to them (Akhkhiyawa) in one of the Hittite texts of that date was read by Dr. Forrer. They were at that time an important naval power situated in the western regions of Asia Minor and the island of Lesbos, and were under the leadership of a prince named Attarsiyas. They appear to have been also in Cyprus and Pamphylia. Later, as has been already mentioned, in the Homeric age the Achaeans were lords of the Peloponnese and as far north as Thessaly, and their name, so far as can be gathered, was employed as a general designation for all Greeks.

The physical characteristics of the Achaeans are difficult to determine, and not a very safe guide. Three passages in the *Odyssey* refer to tallness of stature as a mark of beauty, and it was, perhaps, therefore rare. Heroes are sometimes referred to both by Homer and Hesiod as fair-haired (*ξανθός*) (though the epithet may mean nothing more than not having *black* hair) and we know that both in classical and Roman times blue or grey eyes were rare in Greece.

In classical times the name Achaeans was confined to the people inhabiting the strip of land along the north coast of the Peloponnese, between the Corinthian gulf and the northern Arcadian mountains. They were for the most part subject to Dorian overlords, and their dialect was Doric. After the days of the Macedonian supremacy the Achaean League became one of the most powerful influences in Greece, and it was this fact that led the Romans, when they made the country into a province, to give it the name of Achaea. (*See* DORIANS; IONIANS; GREECE, *History*.)

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**ACHAEMENES** (HAKHAMANI), the eponymous ancestor of the royal house of Persia, the Achaemenidae. According to Darius in the Behistun inscription and Herod. iii. 75, vii. 11, he was the father of Teïspes, the great-grandfather of Cyrus. Whether he really was an historical personage, or merely the mythical ancestor of the family, cannot be decided. According to Aelian (*Hist. anim.* xii. 21), he was bred by an eagle. We learn from Cyrus's proclamation that Teïspes and his successors had become kings of Anshan; *i.e.*, a part of Elam (Susiana), where they ruled as vassals of the Median kings, until Cyrus the Great in 550 B.C. founded the Persian empire. After the death of Cambyses, the younger line of the Achaemenidae came to the throne with Darius, whose father Hystaspes was, like Cyrus, the great-grandson of Teïspes. Cyrus, Darius and all the later kings of Persia call themselves Achaemenides (*Hakhāmanishiya*). With Darius III. *Codomannus* the dynasty became extinct and the Persian empire came to an end (330 B.C.). The adjective *Achaemenius* is used by the Latin poets as the equivalent of "Persian" (Horace, *Odes*, ii. 12, 21). *See* PERSIA. The name Achaemenes is borne by a son of Darius I., brother of Xerxes. After the first rebellion of Egypt, he became satrap of Egypt (484 B.C., Herod. vii. 7). He commanded the Persian fleet at Salamis, and was (460 B.C.) defeated and slain by Inarus (Herod. iii. 12), the leader of the second rebellion of Egypt (*see* also Diodorus xi. 71).

**ACHAEMENIDAE,** the Graecized name of the family of the ancient Persian kings. (*See* PERSIA: *Ancient History*.)

**ACHARD, FRANZ CARL** (1753–1821), Prussian chemist, was born at Berlin on April 28, 1753, and died at Kunern, in Silesia, on April 20, 1821. He was a pioneer in turning to practical account A. S. Marggraf's discovery of the presence of sugar in beetroot, and by the end of the 18th century he was producing considerable quantities of beet sugar, though by a very imperfect process, at Kunern, on an estate which was granted him, about 1800, by the king of Prussia. There, too, he carried on a school of instruction in sugar-manufacture. He published several volumes of chemical and physical researches and discovered, among other things, a method of working platinum.

**ACHARIUS, ERIK** (1757–1819), Swedish botanist, was a pupil of Linnaeus at Uppsala University, and devoted himself to the study of lichens. His most important works are *Lichenographia Universalis* (1810) and *Synopsis methodica Lichenum* (1814).

**ACHATES**, the companion of Aeneas in Virgil's *Aeneid*. The expression "fidus Achates" has become proverbial for a loyal and devoted companion.

**ACHELOUS** (mod. *Aspropotamo* "white river"), the largest river in Greece (130m.) It rises in Mt. Pindus, and, dividing Aetolia from Acarnania, falls into the Ionian Sea. Its water is charged with fine mud, which is deposited along its banks in fertile, marshy plains. At its mouth, a number of small islands (Echinades) have been enveloped in this deposit. It was formerly called Thoas, from its impetuosity, and its upper portion Inachus, the name Achelous being restricted to the shorter eastern branch. The name is given to several other rivers in Greece, and appears in cult and in mythology as that of the typical river-god.

**ACHENBACH, ANDREAS** (1815–1910), German landscape painter, was born at Cassel on Sept. 29, 1815, and died on March 31, 1910. He was a pioneer of the German realistic school He studied at Dusseldorf under Schirmer, but emancipated himself from the contemporary school of landscapists which delighted in the representation of romantic scenery. He was the first artist of the Düsseldorf school who painted nature for its own sake. As a young man he sought inspiration in Holland and Norway. His pictures of the stormy North sea, of Dutch canal scenes and of Rhineland villages contrasted favourably with the sentimental landscapes of his contemporaries. His works are to be found at the Berlin National Gallery, the New Pinakothek in Munich, and the galleries at Dresden, Darmstadt, Cologne, Düsseldorf, Leipzig and Hamburg.

His brother, OSWALD ACHENBACH (1827–1905), is distinguished for his colourful renderings of the Bay of Naples, of Rome and of Venice. He broke away from the traditional classicist interpretation of these scenes and revelled in strong and glowing colour effects. His works are exhibited at most of the important German galleries of modern art.

**ACHERNAR,** $\alpha$ Eridani, the brightest star in the constellation Eridanus (*q.v.*).

**ACHERON** (Gr. river of "woe"), name of several rivers of Greece. In Greek mythology the name is specially given to a river of Hades, over which departed souls were ferried by Charon. Later Greek and Roman poets used it to designate the lower world generally.

**ACHESON, EDWARD GOODRICH** (1856–1931), American inventor, was born at Washington (Pa.), on March 9, 1856. He was compelled to earn his living at an early age, but devoted his leisure to mechanical invention and experiment. Becoming interested in electricity, he entered the employ of Thomas A. Edison. In 1881 he assisted in the preparation of the Edison exhibit at the Paris International Exposition and later, for the Edison interests, installed the first electric lights in Italy, Belgium and Holland. On returning to the United States he resumed his experiments. He discovered a new abrasive substance of great cutting power, which he named carborundum. Inventing a method of producing a remarkably pure synthetic graphite, he organized in 1899 the Acheson Graphite Co., to handle the patent. This company met with great success. His numerous patents cover methods of producing metallic silicon cheaply; the lubricants known as oildag, aquadag and gredag; the treatment of clay to increase plasticity (Egyptianized clay).

**ACHIACHARUS,** the name of an eastern sage whose "sayings" spread far and wide and had a remarkable influence on the world's gnomic literature. His history and moralizing sayings have been preserved, in whole or in part and with interesting minor variations, in Syriac, Arabic, Ethiopic, Armenian and Slavonic translations, and fragments of his teaching have survived among the Jewish papyri from Elephantine (*see* below). Rumanian and old Turkish versions are also in existence.

In the story of his life he is represented as the chief adviser of the Assyrian king Sennacherib. He adopted a nephew, Nadan by name, to succeed him. Profligate and wearied by Achiacharus' unending inculcation of wisdom in proverbial form, Nadar brought about his uncle's downfall. But saved from death by his executioners, Achiacharus survived in an underground dungeon and resumed his former position at court when the king was in dire need of his services as an envoy and magician who could satisfy the demands of the king of Egypt. Thus he built a castle in the air and twisted ropes out of sand. On his return to Assyria he took vengeance on his nephew, flogged him, condemned him to his former dungeon dwelling constantly visited him to taunt him and give him instruction in which, as in Aesop's fables, animals and birds give expression to shrewd moral and ethical ideals Nadan avoided execution by swelling out suddenly and bursting asunder, thus anticipating and possibly inspiring one of the New Testament descriptions of the end of Judas.

The date of composition and the original home of this work are matters of dispute. The Elephantine Papyri provide evidence that it was in existence by the fifth century B.C. The mention of Sennacherib may well point to Mesopotamia as its original home. But the story and the sententious sayings contained in it are probably far older than the Assyrian Empire. Sennacherib's name was probably inserted in the story when it had already assumed a form similar in most other respects and had already embarked on its career of permeating the literature and thought of Palestine, Egypt and the Mediterranean coastlands.

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**ACHILL,** the largest island off Eire, separated from the Curraun peninsula of the west coast by the narrow Achill sound. Pop. (1936) 4,875. It is included in Mayo. Its shape is triangular and is 15 mi. from east to west and 12 mi. from north to south. Area 57 sq.mi. The island is mountainous, the highest points being Slieve Croaghaun (2,192 ft.) in the west, and Slievemore (2,204 ft.) in the north; the extreme western point is the bold and rugged promontory of Achill head, and the northwestern and southwestern coasts consist of cliffs reaching 800 ft. in Minaun, near Keel on the south. The seaward slope of Croaghaun is abrupt and the scenery beautiful. Desolate bogs alternate with the mountains; and the inhabitants earn a scanty subsistence by fishing and tillage, or go to England and Scotland during the harvesting. The Congested Districts board made efforts to improve the condition of the people, and a branch of the Great Southern railway to Achill sound, together with a swivel bridge across the sound, improved communications. In Dugort is a Protestant colony, known as "the Settlement," founded in 1834. There are megalithic remains at Slievemore and elsewhere.

**ACHILLES,** son of Peleus (*q.v.*) and Thetis; bravest, handsomest and swiftest of the army of Agamemnon. According to Homer, he was brought up by his mother at Phthia with his cousin and his intimate friend Patroclus; his teachers were Phoenix and Cheiron. The non-Homeric tales of his childhood contain obvious folk-tale themes. Thetis had seven children, all of whom she put into the fire or a cauldron (*see* HERCULES), to make them immortal. All died save Achilles; because Peleus interfered at this point, Thetis left him. (Fairy Bride theme.) Or, Thetis dipped the child in the waters of the river Styx, by which (like Sigurd Fafnirs-bane) he became invulnerable, except that part of his heel by which she held him; whence the proverbial "heel of Achilles."

During the first nine years of the war as described in the *Iliad*, Achilles ravaged the country round Troy, and took 12 cities. In the tenth year occurred the quarrel with Agamemnon. In order to appease the wrath of Apollo, who had visited the camp with a pestilence, Agamemnon had restored Chryseis, his prize of war, to her father, a priest of the god, but as a compensation deprived Achilles, who had openly demanded this restoration, of his favourite slave Briseis.

Achilles refused further service, and rejected offers of compensation for the insult. During his absence the Greeks were hard pressed, and at last he allowed Patroclus to personate him, lending him his chariot and armour. When Hector slew Patroclus Achilles

was reconciled to Agamemnon, got new armour from Hephaestus. slew Hector, and, after dragging the body about at the wheels of his chariot, restored it to Priam at his earnest entreaty.

The *Iliad* concludes with the funeral rites of Hector. It makes no mention of the death of Achilles, but hints at its taking place "before the Scaean gates." The *Odyssey* mentions his funeral. The *Aethiopsis* took up the story of the *Iliad*. It told how Achilles, having slain the Amazon Penthesileia and Memnon (*q.v.*), was himself slain by Paris, whose arrow was guided by Apollo to his vulnerable heel. He was worshipped in many places: at Leuke, where he was honoured with offerings and games; in Sparta, Elis, and especially Sigeum on the Hellespont, where his famous tumulus was erected.

Behind these legends there probably lies a real man, certainly not a sun-, river- or other god. No certain statue of him, but numerous other representations in art, survive.

BIBLIOGRAPHY.—*See* Preller-Robert, *Gr. Mythologie,* II, iii, 2; Pauly-Wissowa, *Realencyklopädie;* Daremberg and Saglio's *Dictionnaire des Antiquités;* Roscher's *Lexikon,* s.v.; L. R. Farnell, *Hero-cults,* p. 285 *et seq.*

**ACHILLES, TENDON OF:** *see* TENDON OF ACHILLES.

**ACHILLES TATIUS,** of Alexandria, Greek rhetorician, author of the erotic romance, the *Adventures of Leucippe and Cleitophon,* flourished about A.D. 450, perhaps later. Suidas, who alone calls him Statius, says that he became a Christian and eventually a bishop (like Heliodorus, whom he imitated) but there is no evidence of this. Photius, while severely criticizing his lapses into indecency, highly praises the conciseness and clearness of his style, which, however, is artificial and laboured.

The large number of existing mss. attests the popularity of the romance. (*Editio princeps,* 1601; first important critical edition by Jacobs, 1821; later editions by Hirschig, 1856; Hercher, 1858. There are translations in many languages; in English by Anthony H[odges], 1638, and R. Smith, 1855.)

Suidas also ascribes to this author an *Etymology,* a *Miscellaneous History of Famous Men,* and a treatise *On the Sphere.* Part of the last is extant under the title of *An Introduction to the Phaenomena of Aratus.* But if the writer is the *prudentissimus Achilles,* referred to by Firmicus Maternus (about 336) in his *Matheseos libri,* iv, 10, 17 (ed. Kroll), he must have lived long before the author of *Leucippe.* The fragment was first published in 1567, then in the *Uranologion* of Petavius, with a Latin translation, 1630.

**ACHILLINI, ALESSANDRO** (1463–1512), Italian philosopher and anatomist, was born at Bologna, Oct. 29, 1463. A much admired lecturer at Bologna and Padua, he was called the "second Aristotle." He made some important studies of human anatomy and was one of the first anatomists to dissect a human cadaver. His philosophical works were printed in one volume in Venice in 1508, and reprinted with additions in 1545, 1551 and 1568. Among his anatomical writings were *Corporis humani anatomia* and *Anatomicae annotationes.* He died at Bologna on Aug. 2, 1512.

His brother, GIAN FILOTEO ACHILLINI (1466–1538), was the founder of the Academy of Viridario at Bologna in 1511, and the author of *Il Viridario* and other writings, verse and prose. His grand-nephew, CLAUDIO ACHILLINI (1574–1640) was a lawyer who achieved some fame as a versifier of the school of the Secentesti, a group of Italian writers characterized by affectation and extravagance of style.

BIBLIOGRAPHY.—His works were printed at Venice (1508, 1545, 1551 and 1568).

**ACHIMENES,** a genus of plants (family Gesneriaceae, to which belong also Gloxinia and Streptocarpus), natives of tropical America, and well known in cultivation as stove or warm greenhouse plants They are herbaceous perennials, generally with hairy serrated leaves and handsome flowers. The corolla is tubular with a spreading limb, and varies widely in colour, being white, yellow, orange, crimson, scarlet, blue or purple.

**ACHIN** (Dutch, Atjeh), and dependencies, is a Dutch government in Sumatra, Netherlands Indies. It forms the northern extremity of the island, the boundary extending from Salahadji, a point on the east coast, just north of Aru bay, to a point on the west coast, about midway between Singkel and Barus, has an area of 21,448 sq mi. and is divided into four districts It is very mountainous, with long ranges, running parallel with the axis of the island, and, particularly, in the east and extreme northwest, spurs projecting towards the coast. Most of the interior is mountainous, but, except in the extreme north, there is a fairly wide coastal plain, narrower in the east than in the west The highest peaks are Bandahara (9,876 ft) on the southern central boundary, Abongabong (9,794 ft.) in the central part and Leuser (11,092 ft.) in the south. In the north the coast is varied, the cliffs, crowned with dense vegetation, rising precipitously from the sea in places, while in other parts there are beaches or cultivated and populated plains Elsewhere the coast is flat, and, in places, marshy. The rivers are short, run down sharply to the coast, and have little value for shipping, except small native boats. The ports of Achin are Oleh-leh and Sigli on the north and Lhokseumawe and Idi on the east coast, but large vessels go to the free port of Sabang on the island Pulu Weh, 50 mi. north of Oleh-leh. Oleh-leh is the gateway to Kota Raja, the capital of Achin. Kota Raja is situated on the Achin river, some three miles up from the sea The capital of Achin, when this was the wealthiest and most powerful sultanate in northern Sumatra, having suzerainty over territory in the Malay Peninsula, Kota Raja still possesses remains of its former glory, but it consists largely of wooden and attap-roofed houses, built in *kampongs,* with the old Achinese citadel (now garrison-quarters), a large mosque, the modern residences of the governor and civil staff, offices of the administration, European business premises, together with two small hotels. Three bridges span the river. Kota Raja has a cable station, is connected by telegraph with Medan, and then across the island with Padang and the south generally. A steam tramway links it up with Oleh-leh and, across country, with Sigli, on the northeast coast, whence it proceeds to Kuala Simpang (Aru bay), where it joins up with the lines in Deli (east coast of Sumatra province). An agricultural adviser, representing the department of agriculture, trade and industry, is stationed at Kota Raja, and the town has a population of 10,724, composed of 1,137 Europeans and Eurasians, 6,146 natives, and 3,441 foreign Asiatics. The principal industries of Achin are silk weaving, gold working, wood carving and shipbuilding, and there is a fishing and coasting trade. Rice is the food staple, grown more under *sawah* culture than *ladang,* and there are irrigation works for rice culture. Pepper, copra and areca nuts and rubber are the chief exports, but sugar cane and fruit trees are grown, cattle-breeding is carried on. There are over 100,000 ac. under rubber (Hevea). Imports (1939) 2,502,000 and exports 7,442,000 guilders. Pop. (1930) 1,003,062, composed of—Europeans and Eurasians 3,244, natives 975,945, and foreign Asiatics, including Chinese, 23,873. The Achinese are Malayan, but smaller and thinner than the Malays, with darker skin and larger eyes. The people of the highlands (*orang tunŏng*) are prouder and more courageous and independent than those of the lowlands (*orang barŏh*), but both are fond of warfare. The nobility usually claim Arab descent, and there are evidences of old-time contact with Hindus. Both men and women wear the characteristic wide Achinese trousers; the women are skilful weavers; the men fairly good craftsmen and skilled agriculturists. Rice, fish and vegetables, eaten twice daily, form the usual fare, betel-nut is used universally, and opium-smoking is indulged in, but strong drink is used only among the upper classes. Houses are built on piles, divided into several rooms, generally with front and back veranda, reached by steps. They stand in a fenced courtyard, with fruit trees about them—the domestic animals and birds live underneath—and are usually untidy in appearance. In a *meneusah,* without the village, the young unmarried men and strangers sleep, and it is also used for meetings and religious observances. Society is divided into families; there are traces of an old matriarchal form, but the patriarchal system is now general. Marriage is celebrated at an early age, divorce is rare, and polygamy is not common, except among the highest classes. The position of the Achinese woman is high. Achin is under direct Dutch government, but many Achinese chiefs exercise authority as government officials. The Achinese are Mohammedans.

The people are fond of competitions in recitations of poetry and of musical performances on native instruments; also of feasts and gambling, while animals are kept for fighting purposes.

*See* C. Snouck Hurgronje, *The Achehnese* (Leyden, 1906).

### HISTORY

Northern Sumatra was visited by a number of European travellers in the middle ages; for example, Marco Polo, Friar Odoric and Nicolo de' Conti (*qq v.*). But the first voyager to visit Achin, known then by that name, was Alvaro Tellez, a captain of Tristão da Cunha's fleet, in 1506. It was then a mere dependency of the adjoining state of Pedir. By 1526 Achin had assimilated all the other states of northern Sumatra, but its power was at its height in the time of Sultan Iskandar Muda (1607–36). At that period the territory extended from Aru opposite Malacca round the north to Benkulen on the west, 1,100 mi. of seaboard; the island of Nias with the continental states of Johor, Pahang, Kedah and Perak were subject states.

The traders of the 17th century went to Achin for gold. The first Dutch (1599) and first English (1602) commercial ventures to the Indies were to Achin. Letters were sent from Queen Elizabeth and King James I to the princes of Achin. But jealousy and suspicion interfered with trade and the English factory, erected several times, was not long maintained. The French attempted unsuccessfully in 1621 to establish relations as, in spite of all difficulties, the trade was important. William Dampier (*c.* 1688) speaks of the number of foreign merchants settled there

The Portuguese were constantly warring with the kings of Achin until the former lost Malacca (1641). Iskandar Muda sent 60,000 men against Malacca in 1615, but the Portuguese held out. From 1641 four queens successively reigned over Achin, but in 1699 the Arab or fanatical party suppressed female government and put a chief of Arab blood on the throne. From that time Achin's power decayed rapidly.

After the restoration of Java to the Netherlands in 1816 a good deal of weight was attached by the neighbouring British colonies to the maintenance of influence in Achin, and in 1819 a treaty of friendship was concluded by Achin with the Calcutta government which excluded other European nationalities from fixed residence in Achin. When the British government, in 1824, made a treaty with the Netherlands, surrendering the remaining British settlements in Sumatra in exchange for certain possessions on the continent of Asia, no reference was made in the articles to the Indian treaty of 1819; but an understanding was exchanged that it should be modified while no proceedings hostile to Achin should be attempted by the Dutch.

This reservation was formally abandoned by the British government in a convention signed at The Hague on Nov. 2, 1871; and in March 1873 the government of Batavia declared war upon Achin. Doubtless there was provocation, for the sultan of Achin had not kept to the understanding that he was to guarantee immunity from piracy to foreign traders; but the necessity for war was greatly doubted, even in the Netherlands. A Dutch force landed at Achin in April 1873 and attacked the palace but was defeated. Another attempt ended in the fall of Achin in Jan. 1874. General van der Heyden seemed to have quelled them (1878–81), but in 1896 they revolted again and not till 1898 and the succeeding year did General van Heutsz restore order. In 1901 the pretender sultan fled to the Gajoes, a neighbouring tribe inland and for three years heavy fighting went on. Later the coastal regions were subdued, but in the interior there was recurrent trouble. Japan occupied the area in March 1942, during World War II.

*See* P. J. Veth, *Atchin en zijne betrekkingen tot Nederland* (Leyden, 1873); J. A. Kruijt, *Atjeh en de Atjehers* (Leyden, 1877); Kielstra, *Beschrijving van den Atjeh-oorlog* (The Hague, 1885); Renaud, *Jaarboek van het Mynwezen* (1882); J. Jacobs, *Het famille-en Kampongleven op Groot Atjeh* (Leyden, 1894); C. Snouck Hurgronje, *De Atjehers* (Batavia, 1894, trans. 1906); W. Volz, *Nord-Sumatra; Die Gajoländer* (Berlin, 1912). *See* also *Tijdschrift voor Taal en Volkenkunde Nederlandsche Indie.*

**ACHINESE,** a Sumatran tribe of Proto-Malayan stock modified by Hindu and Arab elements, the darker complexion of the lowlanders as distinct from the highlanders of the tribe being attributed to a greater infusion of south Indian blood. They are Muslims but not strict and early in the 13th century became important in the East Indies, having commercial and political relations with Egypt, Europe and Japan Noted for valour and love of freedom, they long maintained their independence against the Dutch. They are excellent craftsmen; women go unveiled and there is little polygamy. Their language, though Malayan, contains many Sanskrit words, and there are other remnants of their former Hindu or Buddhist culture.

*See* E. Marsden, *History of Sumatra* (1783); C. Snouck Hurgronje, *The Achehnese* (1906).

**ACHINSK.** (1) A province in the Siberian area of the R.S F.S.R. Area 25,169 sq.mi. Population 392,900; urban 24,997; rural 367,003. It consists of pine, spruce and birch forest, with open grassy areas on which rye and wheat are grown by the peasants and immigrant colonists. The winter is severe and occasionally early frosts ruin the crops. Gold is found to the west of the town of Achinsk. (2) A market centre, lat. 56° 30′ N., long 90° 35′ E., on the Chulym river, which links it with the Ob river It is on the Trans-Siberian railway and has a branch to the rich Minusinsk district.

**ACHOLI,** a Negro people of the upper Nile valley, akin to the Shilluks of the White Nile. They frequently decorate the temples or cheeks with wavy or zigzag scars and also the thighs with scrolls; some pierce the ears. Their huts are circular with a high peak, a mud sleeping platform, jars of grain and a sunk fireplace; they are decorated with geometrical or conventional designs in red, white or gray. The Acholi are good hunters, using nets and spears, and keep goats, sheep and cattle. In war they use spears and long, narrow shields of giraffe or ox hide. Their language is Nilotic. Their religion is a vague fetishism.

**ACHROMATIC LENS,** a combination of two or more lenses corrected for chromatic aberration. (*See* OPTICS; LENS; PHOTOGRAPHY: *Photographic Lenses.*)

**ACHURCH, JANET** (MRS. C. CHARRINGTON) (1864–1916), English actress, was born in Manchester. She first appeared at the Olympic theatre, London, Jan. 8, 1883, with Geneviève Ward in the farce of *Betsy Baker.* Two years later she joined Frank Benson's company and played Shakespearean heroines; but her chief success was gained as Nora Helmer in Henrik Ibsen's *A Doll's House,* when that play was first produced in England in 1889. She appeared later in other Ibsen plays and in those of Bernard Shaw.

**ACIDALIUS, VALENS** (1567–1595), German scholar and critic, was born at Wittstock on May 25, 1567, and died at Neisse on May 25, 1595, at the age of 28. Acidalius wrote notes on Velleius Paterculus (1590), Curtius (1594), the panegyrists. Tacitus and Plautus, published after his death.

*See* Leuschner, *Commentatio de A. V. Vita, Moribus, et Scriptis* (1757).

**ACIDIMETRY,** the determination of the quantity of available acid in a sample of material. (*See* CHEMISTRY: *Analytical Chemistry.*)

**ACIDS AND BASES.** Acid is the name loosely applied to any substance which, in water solution, tastes sour, changes the colour of indicators (*e g.,* reddens blue litmus), reacts with some metals (*e.g.,* iron) to liberate hydrogen and "neutralizes" bases. Base is the name loosely applied to any substance which, in water solution, is slippery to the touch, tastes bitter, reverses the colour changes produced by acids on indicators (*e.g.,* turns red litmus blue) and neutralizes acids. Neutralization is the process whereby an acid and a base enter into a chemical reaction which destroys the characteristic properties of both and produces a compound known as a salt.

There are several different scientific definitions of acids and bases in current use; these will be explained below.

Among the industrially important acids are sulphuric, nitric, hydrochloric, phosphoric and acetic; among the industrially important bases are sodium and potassium hydroxides, sodium and potassium carbonates, calcium oxide (lime) and ammonia. Sulphuric acid (*q.v.*) is manufactured in the United States for about

$17 a ton at the rate of more than 8,000,000 tons per year. It is thus one of the most important of chemical products; the tonnage produced annually greatly exceeds that of any metal except iron. Sulphuric acid is used in the refining of petroleum, in storage batteries, in "pickling" steel, in the manufacture of fertilizer, etc. Nitric acid (*q.v.*) and acetic acid (*q v.*) are widely used in chemical industry. Among the uses for the former are the manufacture of explosives and of dyestuff intermediates; among the uses for the latter are the manufacture of plastics and of solvents. Sodium and potassium hydroxide (*see* ALKALI) are used in soap manufacture; sodium carbonate is one of the important ingredients for the manufacture of glass and is used in the household as washing soda. Ammonia (*q v.*) is widely used, in the form of ammonium sulphate, as a fertilizer; it is also the raw material for the production of much nitric acid. The references already cited give the details regarding the manufacture and use of these compounds; here only the theory of acids and bases is considered.

**History.**—Almost the only acid substance known to the Egyptians, Greeks and Romans was vinegar which was produced by the action of air on wine (fermentation). Vinegar is a dilute and impure solution of acetic acid in water; the word "acid" is derived from the Greek ὀξύς, sour, and ὄξος, vinegar. Impure acetic acid (vinegar) was utilized industrially by the ancients. Theophrastus of Eresus, in the 4th century B.C., gave directions quite similar to comparatively modern ones for the preparation of white lead pigment from vinegar and metallic lead. Sodium carbonate (obtained by the evaporation of alkaline water from arid regions) and potassium carbonate (from wood ashes) were known in ancient times; lime was obtained, as it is today, by roasting calcium carbonate. The manufacture of sodium and potassium hydroxides by the action of lime on sodium and potassium carbonates was also practised. The exact dates at which these substances were first prepared are unknown, but the manufacture of glass (which requires sodium carbonate) was practised in Egypt at least as early as 1400 B.C.

During the middle ages, the alchemists slowly increased the knowledge of acids and bases. The preparation of nitric acid (*aqua fortis*) by the destructive distillation of a mixture of alum, iron sulphate and potassium nitrate was described by Geber around 1300, and the preparation of sulphuric acid by the destructive distillation of iron sulphate was known before 1600. (*See* ALCHEMY.) Still later, an explanation was sought for the behaviour of acids and bases. One of the early theories was that of Bertrand (1683), who suggested that ". . . an acid is a liquid body composed of small, firm and pointed particles, slightly resembling fine and delicate needles." He supposed that alkalis consist of "particles which have between their junctions pores of different structures" and that neutralization results when the needles of the acid enter the pores of the alkali. According to the phlogiston theory current in the early 18th century, the acids, such as sulphurous, phosphoric, etc., which are produced by combustion, were regarded as elementary substances. This misapprehension was abandoned along with the phlogiston theory, and temporarily replaced by Antoine Laurent Lavoisier's doctrine (1778) that oxygen is the acid-producing element. About 1808–10, the researches of Sir Humphry Davy and of J. L. Gay-Lussac and L. J. Thénard on hydrochloric acid established beyond doubt that hydrogen and not oxygen is the element essential (although not sufficient) for acidic properties. The hydrogen theory of acids was extended by S. A. Arrhenius, who showed (1887) that, in aqueous solution, acids are partly ionized (*i.e.*, they are partly separated into charged particles called ions). He further suggested that an acid should be defined as a substance which ionizes in water to yield hydrogen ions; a base should be defined as a substance which ionizes in water to yield hydroxide ions. The definitions of acids and bases given above will hereafter be called the "classical" ones. For example, nitric acid was assumed to ionize according to equation (1a); sodium hydroxide according to equation (1b):

$$HNO_3 \rightleftarrows H^+ + NO_3^-. \qquad (1a)$$

$$NaOH \rightleftarrows Na^+ + OH^-. \qquad (1b)$$

The characteristic properties of acids and bases were ascribed respectively to the hydrogen ion, $H^+$, and the hydroxide ion, $OH^-$. A substance containing hydrogen which does not ionize in aqueous solution to produce hydrogen ions (*e.g*, methane, $CH_4$) is then not an acid. In qualitative terms, a strong acid, when dissolved in water, largely or completely ionizes and thus produces a high concentration of hydrogen ions, whereas a weak acid when dissolved in water is only slightly ionized, and thus produces only a low concentration of hydrogen ions. Modern concepts of both acids and bases have been developed from Arrhenius' theory.

**The "Hydrogen-Ion" Theory of Acids.**—An enormous amount of evidence supporting Arrhenius' theory of acids and bases has been accumulated since the 1880s. (*See* SOLUTIONS. *Solutions of Electrolytes.*) It is a pertinent fact, for example, that a solution of hydrochloric acid in water conducts electricity and that, when the current passes, hydrogen gas is liberated at the negative electrode (*i.e.*, the cathode). In dilute solutions of the acid, oxygen is liberated at the positive electrode (*i.e*, the anode). These facts (and many others) can be explained by assuming that hydrochloric acid in aqueous solution is an assembly of chloride ions, $Cl^-$, and of hydrogen ions. The hydrogen ion, $H^+$, exists in water only as the hydrate, $H_3O^+$($H^+$ plus $H_2O$), called the hydronium ion; the evidence for this statement will be presented later.

Many of the reactions of aqueous solutions of acids and bases can be explained on the basis of the ionic theory. For example, the existence of charged particles in the solution accounts for the fact that the solution conducts electricity. The existence of $H_3O^+$ ions (hydrated hydrogen ions) is consistent with the fact that hydrogen gas is liberated at the cathode, for these positively charged hydronium ions are repelled by the positive electrode and attracted to the negative one, where they are discharged; hydrogen and water are thus liberated.[1] Similarly, a solution of sodium hydroxide in water is assumed to consist of an assembly of sodium ions, $Na^+$, and hydroxide ions, $OH^-$. During electrolysis, the negatively charged hydroxide ions migrate toward the anode and are there discharged to form oxygen and water. The interpretation here advanced is made much more plausible by quantitative experiments on the changes in composition which, during electrolysis, take place in those portions of the solution near the electrodes (transference experiments; *see* ELECTROCHEMISTRY).

The ionic theory helps to account for differences in the strengths of acids and bases. Any acid, HA, when introduced into water, rapidly comes to chemical equilibrium with its ions (see *Quantitative Studies of Acids and Bases*, below; also THERMODYNAMICS):

$$HA + H_2O \rightleftarrows H_3O^+ + A^-. \qquad (2)$$

Bases ionize similarly to give hydroxide ions. Such an ionization reaction may be essentially complete, as it is in an aqueous solution of the strong base sodium hydroxide, which is largely ionized even in the solid state; or it may be far from complete, as it is in an 0.1 molar aqueous solution of acetic acid, where less than 1.5% of the acid is dissociated into ions, and the rest remains as un-ionized molecules.

The ionic theory is also useful in explaining the process of neutralization. When an acid and a base neutralize one another, the hydronium (hydrated hydrogen ion) and hydroxide ions combine to form water; if equivalent quantities of the two materials are present, the reaction proceeds essentially to completion because water is only slightly dissociated into ions. The chemical equation for the reaction between potassium hydroxide and hydrochloric acid is written

$$K^+ + OH^- + H_3O^+ + Cl^- \rightleftarrows K^+ + Cl^- + 2H_2O, \qquad (3)$$

which may be simplified to

$$OH^- + H_3O^+ \rightleftarrows 2H_2O, \qquad (3a)$$

[1]Although all acids when electrolyzed liberate hydrogen at the cathode, it is not true that all compounds which liberate hydrogen at the cathode are acids. During the electrolysis of the aqueous solutions of some salts, the weak acid water, rather than the salt itself, is decomposed. Such salts, however, have no acidic properties, for example, they do not redden blue litmus.

where the potassium and chloride ions, which do not really enter into the chemical reaction, are omitted. However, these ions are present after the neutralization; with the water produced by the neutralization and the excess water present as a solvent, the ions form a solution of potassium chloride (a salt).

Many acids ionize in water to give more than one hydronium ion; these are called polybasic acids because each molecule of acid can neutralize more than one molecule of base. For example, sulphuric acid is dibasic; it ionizes in two steps.

$$H_2SO_4+H_2O \rightleftarrows H_3O^+ + HSO_4^-, \qquad (4)$$
$$HSO_4^- + H_2O \rightleftarrows H_3O^+ + SO_4^{--},$$

and forms two series of salts, corresponding to $NaHSO_4$ and $Na_2SO_4$; phosphoric acid ($H_3PO_4$) is tribasic and forms three series of salts. Bases (*e.g.*, $Ba[OH]_2$) which can ionize to give more than one hydroxide ion per molecule are called polyacid bases. The characteristic reactions of acids other than neutralization and salt formation (*e g*, the colour changes of indicators, the formation of hydrogen with metals and of carbon dioxide with carbonates) can also be explained in terms of the ionic theory. Furthermore, this theory has led to an understanding of the mechanism by which acids catalyze some reactions. For example, the role of strong acids in the bromination of acetone is explained in terms of ionization equilibria. (*See* REACTION KINETICS) The explanations for the characteristic reactions of bases parallel those for the reactions of acids.

Some acids are inorganic compounds and some are organic compounds Among the former are sulphuric, nitric, hydrochloric, perchloric, hydrofluoric, hydrobromic, phosphoric, sulphurous, hypochlorous and arsenic acids. The organic acids are further subdivided according to the structural feature in the molecule which is responsible for the acid properties. For example, there are carboxylic acids (acetic, butyric, benzoic, phthalic, stearic, oleic, etc.), sulphonic acids (benzene sulphonic acid, naphthalene disulphonic acid, etc.), phenols (phenol, or carbolic acid, cresol, etc ), enols (ascorbic acid or vitamin C, etc ) and other types too numerous to mention. Bases include the hydroxides of sodium, potassium, calcium, barium, copper, iron and other metals, as well as the hydroxides related to ammonia and to numerous organic compounds most of which are amines (compounds closely related to ammonia) such as methylamine, aniline and pyridine. There are a few compounds such as aluminum and zinc hydroxides and water, which have both slight acidic and slight basic properties; these substances are called amphoteric.

**The Hydronium Ion.**—The hydrogen ion in aqueous solution was for a long time written simply as $H^+$. This notation implied that the proton (the nucleus of a hydrogen atom [*see* ATOM]) could exist free in solution. The proton has no electrons around its nucleus and is therefore a small particle. Hence, the electrostatic field in its neighbourhood should be great. On these theoretical grounds, the existence of protons in aqueous solution appears doubtful. All the ions known to exist under such conditions have two or more electrons around their nuclei. A number of experiments have lent support to the notion that the hydrogen ion exists in aqueous solution only as the hydronium ion, $H_3O^+$. Among these can be cited the fact that liquid hydrogen chloride is a nonconductor of electricity. This compound, however, when dissolved in water, conducts current well. These phenomena are just what would be expected if pure hydrogen chloride did not ionize (*i.e.*, if $H^+$ alone could not exist under the conditions cited). When gaseous hydrogen chloride dissolves in water, the following strongly exothermic reaction presumably takes place.

$$HCl+H_2O \rightleftarrows H_3O^+ + Cl^-. \qquad (5)$$

X-ray analysis shows definitely that the hydronium ion does exist at least under certain circumstances. For example, the lattice of crystalline perchloric acid monohydrate consists of hydronium and perchlorate ($ClO_4^-$) ions. It is true that ions other than the hydrogen ion interact with water; moreover, hydronium ion in aqueous solution tends to combine with water to form hydrates of an indefinite type. But whereas, in crystalline and molten salts, ions other than the hydrogen ion can exist, there is no evidence for the existence of uncombined protons in either solid or liquid phases. (Free protons can exist under special circumstances in the gas phases; *e.g*, in a cyclotron.) In view of these facts, the hydronium ion, $H_3O^+$, will here be written for the hydrogen ion in aqueous solution.

**Bronsted-Lowry Definition.**—A broader definition of acids and bases was introduced by J. N. Bronsted and T. M. Lowry simultaneously and independently in 1923 According to this definition, any compound which can transfer a proton to any other compound is an acid; the compound which accepts the proton is a base. Two considerable advantages of the Bronsted-Lowry definition are that it can be applied to nonaqueous solutions and that it codifies and simplifies acid-base reactions. It is not inconsistent with the classical definition of acids in terms of hydrogen ions, but is rather an extension of the older concept. According to the Bronsted-Lowry scheme, all acid-base equilibria are then represented by the equation:

$$\text{Acid}_1+\text{base}_2 \rightleftarrows \text{base}_1+\text{acid}_2$$
$$\text{or } HA+B \rightleftarrows A^- + BH^+. \qquad (6)$$

Here $A^-$ and B are described as the conjugate bases of the acids HA and $BH^+$, respectively; similarly, HA and $BH^+$ are the conjugate acids of the bases $A^-$ and B. In such generalized equations the presence or absence of an electric charge on any particle does not necessarily indicate the net charge on the particle in question. It merely shows that an acid has one more positive or one less negative charge than its conjugate base, and conversely that a base has one less positive charge or one more negative charge than its conjugate acid. Examples of acid-base equilibria are shown in equations (7a) and (7b):

$$H_3O^+ + NH_3 \rightleftarrows H_2O + NH_4^+, \qquad (7a)$$
$$H_2O + CH_3CO_2^- \rightleftarrows OH^- + CH_3CO_2H. \qquad (7b)$$

In these equations, ammonium ion is the acid conjugate to the base ammonia, acetic acid is the acid conjugate to the base acetate ion, hydronium ion is the acid conjugate to the base water, and water is the acid conjugate to the base hydroxide ion. (Water is thus seen to be amphoteric.) According to the Bronsted-Lowry scheme, the existence of acids implies the existence of bases (and vice versa), just as the existence of oxidizing agents implies the existence of reducing agents (and vice versa).

It has long been known that an aqueous solution of pure sodium acetate gives a basic reaction toward litmus. This fact may be explained by equation (7b), which shows that the reaction between water and acetate ion produces some hydroxide ions, which are responsible for the colour changes of the indicator. In classical language, reaction (7b) is described as the hydrolysis of the acetate ion; in Bronsted-Lowry's terminology, it is called the ionization of the base, acetate ion.

The hydrolysis (equation [7a]) of ammonium chloride (classical) is similarly replaced by the ionization of the acid, ammonium ion (Bronsted-Lowry). A solution of aniline hydrochloride has about the same acidity as one of acetic acid; it is, therefore, both convenient and informative to state that the anilinium ion, $C_6H_5NH_3^+$, is an acid of about the same strength as acetic acid.

The Bronsted-Lowry definition considerably enlarges the number of compounds considered (on the basis of the classical definition) as acids and bases. The class of bases is expanded to include not only the hydroxide ion and amines but also the acetate ion, phosphate ion, carbonate ion, sulphide ion, etc., since each of these negative ions can acquire a proton from an appropriate acid. Similarly, the class of acids is expanded to include the ammonium ion, anilinium ion, the oxonium ion of alcohol, etc., since each of these positive ions can transfer a proton to an appropriate base. Furthermore, the hydrogen (or hydronium) and hydroxide ions are no longer considered the exclusive bearers of acidic and basic properties; an example in which un-ionized molecules function as acids is afforded by the phenomenon of general acid catalysis.

One of the characteristic properties of acids and of bases is that they increase the rate of (*i.e.*, they catalyze) certain chemi-

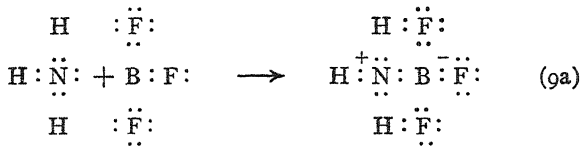
cal reactions. There are a number of reactions, such as the hydrolysis (inversion) of cane sugar, which are catalyzed exclusively by hydronium ions; similarly, there are reactions catalyzed exclusively by hydroxide ions. But there are reactions (*e g*, the decomposition of nitramide) which are catalyzed by all bases, reactions (*e.g.*, the hydrolysis of ethyl orthoacetate) which are catalyzed by all acids and reactions (*e g*, the bromination of acetone) which are catalyzed by all acids and all bases, the terms acid and base being used here in the Bronsted-Lowry sense

The rate constant (*see* REACTION KINETICS) for a reaction of the third type can be represented as a sum

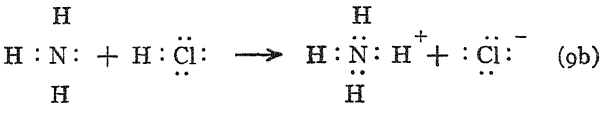
$$k = k_O + \sum_A k_A c_A + \sum_B k_B c_B, \qquad (8)$$

where $k_A$ is the rate constant associated with each acid present at a concentration $c_A$, $k_B$ is the rate constant associated with each base present at a concentration $c_B$, $k_o$ is the rate constant for catalysis by water and the symbol $\sum$ indicates a summation over all acids (or bases) present in the solution. In those general acid or general base reactions, the mechanism of which is understood, the rate-controlling step is actually the acid-base reaction; *e.g.*, the reaction whereby a base removes a proton from a weak acid. Here the usefulness of the Bronsted-Lowry definition is obvious

**Lewis Definition.**—G. N. Lewis has suggested (1923) a definition for the word acid which extends this class of compounds even beyond the limits set by Bronsted and Lowry. According to the electronic concept of valence (*see* CHEMISTRY), a proton from an acid, during neutralization, becomes attached to an unshared pair of electrons in the molecule of a base. Lewis used the word acid to include all substances which, during a chemical reaction, become attached to an unshared pair of electrons in some other molecule. This definition includes, besides the conventional acids, such substances as aluminum chloride, boron trifluoride and zinc chloride. For example, boron trifluoride (*see* equation [9a]) reacts with ammonia much as does hydrogen chloride (equation [9b]). The electronic structures of the reactants and reaction products are shown in equations (9a) and (9b):



(9a)



(9b)

Furthermore, in certain nonaqueous solvents, boron trifluoride and aluminum chloride react with indicators to produce the same colour changes produced by conventional acids; these same reagents catalyze many reactions (*e g.*, the Friedel-Crafts reaction) which are known to be acid catalyzed. It should be noted that the Lewis definition of acid departs from both the classical and Bronsted-Lowry use of the word, in that hydrogen is no longer considered essential to acidity.

The analogy which Lewis has pointed out between conventional acids, such as sulphuric, and materials, such as boron fluoride, is an important one. Whether these materials should be called acids is a matter of nomenclature depending on personal preference and usage. Most chemists in 1946, however, referred specifically to the substances in question as "Lewis acids" or as "electrophilic reagents" or as "cationoid reagents."

**Quantitative Studies of Acids and Bases.**—It has previously been pointed out that those acids which in aqueous solution are largely dissociated into ions are called strong acids; those which under similar conditions are only slightly dissociated are called weak acids. There have been many quantitative investigations of the strengths of acids in various solvents; here only aqueous solutions will be discussed.

In water, any acid HA is ionized according to equation (2),

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-. \qquad (2)$$

The equilibrium constant for the reaction is represented by equation (10)

$$\frac{[H_3O^+][A^-]}{[HA]} = K_A, \qquad (10)$$

where the expressions in brackets represent the activities of the acid and its ions. (The activity of each ion or molecule is approximated in dilute solution by its concentration, *see* THERMODYNAMICS.) The activity of water is omitted from equation (10) because it is for all practical purposes constant and can therefore be included in the equilibrium constant $K_A$ A strong acid then is one with a large value for its ionization constant $K_A$; indeed, the value of this constant is a quantitative measure of the strength of the acid in question In accordance with the equation (10), the more dilute the solution, the more extensively is the acid ionized. If it is possible by some analytical technique to determine the concentration of hydronium ions in solution, where the gross concentration of ionized and un-ionized acid is known, $K_A$ may be computed. No purely chemical method of analysis for $H_3O^+$ can succeed because, when hydronium ions are removed by any reaction whatsoever, the equilibrium (2) is rapidly re-established and more acid is ionized. Chemical methods, therefore, determine only the gross amount of acid present, not the amount ionized at any given moment; these methods are then useful for quantitative analysis of solutions of acids and bases. There are, however, many physical methods for determining the momentary concentration (or activity) of the hydronium ions. (*See* HYDROGEN IONS.) They include colorimetric, conductimetric, electrometric, catalytic and other methods Here only the colorimetric method will be outlined, as an example of the type of procedure which can be employed.

If the ion $A^-$, or the acid HA, is coloured, or if both are coloured and the colours differ, then the ionization constant can be determined colorimetrically. The colour intensity per mole of the ion $A^-$ is determined from a solution of its sodium or potassium salt; the colour intensity per mole of the acid HA is determined from an aqueous solution of a mixture of the acid in question and some strong acid (such as hydrochloric) which represses the ionization of the weaker acid. The concentrations of the ion $A^-$ and of the acid HA are then determined colorimetrically, or spectrophotometrically, for any solution in which both are present. From considerations of electrical neutrality, the concentration of hydronium ion can then be computed. The method described can be extended to include ultra-violet and Raman as well as visible spectra.

The ion product of water, $K_W$, has been accurately determined (*see* equation [3a]) and from this constant and the ionization constant of any acid, the ionization constant of the conjugate base may be computed as follows:

$$[H_3O^+]\ [OH^-] = K_W = 1 \times 10^{-14} \text{ at } 25^\circ \text{ C.},$$
$$\frac{[H_3O^+]\ [A^-]}{[HA]} = K_A, \qquad (11)$$
$$\frac{[HA]\ [OH^-]}{[A^-]} = K_W/K_A = K_B.$$

Here as before the symbols HA and $A^-$ do not necessarily represent uncharged and charged particles, respectively; they are intended only to show that any acid has one more positive charge (or one less negative charge) than its conjugate base. For example, it is convenient sometimes to speak of the acid strength of the ammonium ion and sometimes of the base strength of ammonia; the two ionization constants are related by equations (11).

It is to be noted that, with an amphoteric substance, HA, the equations (11) relate the acid ionization constant of HA with the basic ionization constant of the conjugate base $A^-$, and also relate the basic ionization constant of HA with the acid ionization constant of the conjugate acid $H_2A^+$. There is on the other hand no general quantitative relationship between the acid and basic ionization constants of the amphoteric substance HA, itself.

In aqueous solution, sulphuric acid, nitric acid and hydrochloric acid are all strong acids; that is to say, they are all largely ionized. The ionization constant of hydrochloric acid and the first ionization constant of sulphuric acid are in fact so large that they have not yet been properly measured in water; the ionization constant of nitric acid, although large, is measurable Most organic acids, on the other hand, are weak acids, and some of them are very weak. Table I contains the ionization constants of some representative acids.

TABLE I.—*The Ionization Constants of Selected Acids in Water (25° C)*

| Acid | $K_A$ |
|---|---|
| Perchloric acid ($HClO_4$) | Too great to measure |
| Benzene sulphonic acid ($C_6H_5SO_3H$) | Too great to measure |
| Sulphuric acid ($H_2SO_4$) | Too great to measure |
| Hydrochloric acid (HCl) | Too great to measure |
| Nitric acid ($HNO_3$) | Too great to measure |
| Bisulphate ion ($HSO_4^-$) | $1.0 \times 10^{-2}$ |
| Phosphoric acid ($H_3PO_4$) | $7.5 \times 10^{-3}$ |
| Sulphurous acid ($H_2SO_3$) | $1.3 \times 10^{-2}$ |
| Chloroacetic acid ($CH_2ClCO_2H$) | $1.38 \times 10^{-3}$ |
| Formic acid ($HCO_2H$) | $1.8 \times 10^{-4}$ |
| Acetic acid ($CH_3CO_2H$) | $1.8 \times 10^{-5}$ |
| Carbonic acid ($H_2CO_3$) | $4.3 \times 10^{-7}$ |
| Dihydrogenphosphate ion ($H_2PO_4^-$) | $6.2 \times 10^{-8}$ |
| Phenol ($C_6H_5OH$) | $1.1 \times 10^{-10}$ |
| Bicarbonate ion ($HCO_3^-$) | $4.7 \times 10^{-11}$ |
| Water ($H_2O$) | $1.8 \times 10^{-16}$ |
| Acetophenone ($C_6H_5COCH_3$) | Too small to measure |
| Triphenylmethane $(C_6H_5)_3CH$ | Too small to measure |

It should be pointed out that most of the ionization constants which cannot be measured for aqueous solution can be measured (or at least estimated) for solutions in other solvents. The strengths of some representative bases are shown in Table II.

TABLE II.—*The Ionization Constants of Selected Bases in Water (25° C)*

| Base | $K_B$ |
|---|---|
| Sodium hydroxide (NaOH) | Too great to measure |
| Guanidine ($NH_2C[NH]NH_2$) | Too great to measure |
| Diethylamine ($[C_2H_5]_2NH$) | $9.6 \times 10^{-4}$ |
| Ammonia ($NH_3$) | $1.8 \times 10^{-5}$ |
| Diethanolamine ($[C_2H_4OH]_2NH$) | $7.6 \times 10^{-7}$ |
| Diethylaniline ($C_6H_5N[C_2H_5]_2$) | $3.7 \times 10^{-8}$ |
| Aniline ($C_6H_5NH_2$) | $3.8 \times 10^{-10}$ |
| Water | $1.8 \times 10^{-16}$ |
| Urea | Too small to measure |
| Acetanilide | Too small to measure |

It should be noted that with the aid of equations (11) all the data in Tables I and II could have been presented respectively in terms of the ionization constants of the conjugate bases and acids.

The differences in acid and base strength among compounds of the types listed have to a considerable extent been accounted for. The fact that ammonia is a much stronger base than water is related to the atomic structures of nitrogen and oxygen. Oxygen, with a higher nuclear charge, does not attract the positively charged protons as strongly as does nitrogen. The fact that aniline is a weak base compared with ammonia has been ascribed to quantum mechanical resonance (*see* RESONANCE, THEORY OF), and the fact that chloroacetic acid is stronger than acetic acid has been ascribed to the electrostatic effect of the carbon-chlorine dipole.

For some purposes it is convenient to speak not of the activity of the hydronium ion but of the logarithm of that quantity.

For a discussion of this matter *see* HYDROGEN IONS.

**Nonaqueous Solvents.**—Water solutions have been more thoroughly investigated than any other solutions, but the phenomena of acidity and basicity are by no means limited to solutions in water; in fact, nonaqueous solutions exhibit a broader range of acidity and basicity than do aqueous solutions. In water solution, no acid much stronger than $H_3O^+$ can exist, for otherwise it would transfer a proton to the solvent; similarly, in water solution no base much stronger than hydroxide ion can exist since otherwise this base would react with water and accept a proton from it. For nonaqueous solvents, the classical definitions of acids and bases must be abandoned; the simplest adequate definition is that of Bronsted and Lowry.

Two solvents of particular interest, which illustrate the principles involved, are liquid ammonia (boiling at −33° C.) and pure acetic acid (b.p 118° C.) An acid dissolved in liquid ammonia reacts with the solvent according to equation (12):

$$HA + NH_3 \rightleftarrows A^- + NH_4^+. \qquad (12)$$

This equation is analogous to equation (2) for water In liquid ammonia, the ammonium ion is the solvated proton; it functions as an acid. Similarly, the amide ion, $NH_2^-$, functions as a base Solutions of the ammonium ion in liquid ammonia liberate hydrogen from active metals (*e.g.*, sodium), change the colour of indicators, conduct electricity and neutralize solutions of amide ions Both the acid in the ammonia system, $NH_4^+$, and the base, $NH_2^-$, exert strong catalytic effects on reactions carried out in ammonia.

Acids and bases function in analogous fashion in glacial acetic acid. Here the strongest possible base is the acetate ion; any stronger base reacts with the solvent

$$B + CH_3CO_2H \rightleftarrows BH^+ + CH_3CO_2^- \qquad (13)$$

Strong acids such as sulphuric ionize according to the equation

$$H_2SO_4 + CH_3CO_2H \rightleftarrows HSO_4^- + CH_3CO_2H_2^+. \qquad (14)$$

Solutions of both acids and bases in acetic acid neutralize one another, conduct electricity and strongly catalyze chemical reactions.

A valuable acidity scale has even been constructed for sulphuric acid as a solvent; many of the important chemical properties of this acid have thereby been correlated and explained.

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(F. H. WR.)

**ACINACES,** from the Greek. An ancient Persian sword, short and straight, and worn, contrary to the Roman fashion, on the right side, or sometimes in front of the body, as shown in the bas-reliefs found at Persepolis Among the Persian nobility it was frequently made of gold, being worn as a badge of distinction. The acinaces was an object of religious worship with the Scythians and others (Herod., iv, 62).

**ACIREALE** (anc. Acis), town and episcopal see, province of Catania, Sicily; 9 mi. N.E. from Catania by rail Pop. (1936) 19,440 (town), 36,871 (commune). The thermal springs were used by the Romans.

Acireale took its name from the river Acis, into which Acis, the lover of Galatea, was changed after he had been slain by Polyphemus.

**ACIS,** in Greek mythology, the son of Pan (Faunus) and the nymph Symaethis, a beautiful shepherd of Sicily, the lover of the Nereid Galatea. His rival, the Cyclops Polyphemus, surprised them together and crushed him to pieces with a rock. His blood, gushing forth from beneath, was metamorphosed by Galatea into the river bearing his name (now Fiume di Jaci) (Ovid, *Met*, xiii, 750; Silius Italicus, *Punica*, xiv, 221).

**ACKER, CHARLES ERNEST** (1868–1920), U.S. inventor and manufacturer, was born in Bourbon, Ind., on March 19, 1868. Following his graduation from Cornell university in 1888 he practised electrical engineering in Chicago, Ill., until 1893. He originated a process for making caustic soda from molten salt by electrolysis and established works in Niagara Falls, N.Y., for the manufacture of soda and other chemical products. He devised various other chemical and electrochemical processes, and obtained numerous patents for his inventions pertaining to electrochemical manufacture. In recognition of his services to chemical technology he was awarded in 1902 the Elliott Cresson medal of the Franklin institute.

Acker died in Ossining, N.Y., on Oct. 18, 1920.

**ACKERMAN, FRANCIS** (*c.* 1335–1387), Flemish soldier

and diplomat, was born at Ghent. He was partly responsible for inducing Philip van Artevelde to become first captain of the city of Ghent in 1382. He secured for Ghent assistance from the citizens of Brussels, Louvain and Liège, and, as admiral of the Flemish fleet, visited England and obtained a promise of help from King Richard II.

After Artevelde's death in Nov. 1382, Ackerman acted as leader of the Flemings. He took part in the conclusion of the treaty of peace between Ghent and Philip the Bold, duke of Burgundy, in Dec. 1385 Trusting in Philip, and ignoring the warnings of his friends, Ackerman remained in Flanders and was murdered at Ghent on July 22, 1387, leaving a memory of chivalry and generosity.

*See* Jean Froissart, *Chroniques*, ed by S. Luce and G Raynaud (Paris, 1869–97); Johannes Brandon, *Chronodromon*, ed by K. de Lettenhove in the *Chroniques relatives à l'histoire de la Belgique sous la domination des ducs de Bourgogne* (Brussels, 1870).

**ACKERMANN, JOHANN CHRISTIAN GOTTLIEB** (1756–1801), German physician, was born at Zeulenroda, in Upper Saxony, on Feb. 17, 1756, and died at Altdorf on March 9, 1801. At the age of 15 he became a student of medicine at Jena under E. G. Baldinger, whom he followed to Göttingen in 1773, and later he studied for two years at Halle. A few years of practice at Stendal, 1778–99, where there were numerous factories, enabled him to add many valuable original observations to his translation, 1780–83, of Bernardino Ramazzini's (1633–1714) treatise on diseases of artificers.

In 1786 he became professor of medicine at the University of Altdorf, in Franconia, occupying first the chair of chemistry and then, from 1794 until his death in 1801, the chair of pathology and therapeutics.

He wrote *Institutiones Historiae Medicinae* (Nuremberg, 1792) and *Institutiones Therapiae Generalis* (Nuremberg and Altdorf, 1784–95), in addition to various handbooks and translations.

**ACKERMANN, LOUISE VICTORINE CHOQUET** (1813–1890), French poet, was born in Paris on Nov. 30, 1813. Educated by her father in the philosophy of the encyclopaedists, Victorine Choquet went to Berlin in 1838 to study German, and there married in 1843 Paul Ackermann, an Alsatian philologist After little more than two years of happy married life her husband died, and Mme. Ackermann went to live at Nice. In 1855 she published *Contes en vers*, and in 1862 *Contes et poésies*. Very different from these simple and charming *contes* is the work on which Mme. Ackermann's real reputation rests. She published in 1874 *Poésies, premières poésies, poésies philosophiques*, a volume of sombre and powerful verse, expressing her revolt against human suffering. Soon after the publication of this volume Mme. Ackermann moved to Paris, where she gathered round her a circle of friends, but published nothing further except a prose volume, the *Pensées d'une solitaire* (1883; Eng. trans., Glasgow, 1921), to which she prefixed a short autobiography. She died at Nice on Aug. 2, 1890.

BIBLIOGRAPHY.—Anatole France, *La Vie littéraire*, 4th series (1892); the comte d'Haussonville, *Mme. Ackermann* (1882); M. Citoleux, *La Poésie philosophique au XIX^e siècle*, vol. i (1906); O. B. P. G de Cléron, *Mme. Ackermann d'après des lettres et des papiers inédits* (1892).

**ACKERMANN, RUDOLPH** (1764–1834), Anglo-German inventor and publisher, was born on April 20, 1764, at Schneeberg, in Saxony. He had been a saddler and coachbuilder for ten years in different German cities and in Paris and London, when, in 1795, he established a print shop and drawing school in the Strand. Ackermann set up a lithographic press, and applied it in 1817 to the illustration of his *Repository of Arts, Literature, Fashions, etc.* (monthly until 1828). Thomas Rowlandson and other distinguished artists were regular contributors. He also introduced the fashion of the once popular English annuals, beginning in 1825 with *Forget-Me-Not;* and he published many illustrated volumes of topography and travel—*The Microcosm of London* (1808–11), *Westminster Abbey* (1812), *The Rhine* (1820), *The World in Miniature* (1821–26), etc. Ackermann was an enterprising man; he patented (1801) a method for rendering paper and cloth waterproof, erected a factory at Chelsea for the purpose and was one of the first to illuminate his own premises with gas Indeed, the introduction of lighting by gas owed much to him After the battle of Leipzig Ackermann collected nearly £250,000 for German sufferers He died at Finchley, Middlesex, on March 30, 1834

**ACKNOWLEDGMENT**, an admission that something has been given or done, a term used in law in various connections The acknowledgment of a debt, if in writing signed by the debtor or his agent, is sufficient to take it out of the statutes of limitations. The signature to a will by a testator, if not made in the presence of two witnesses, may be afterward acknowledged in their presence The acknowledgment by a woman married before 1882 of deeds for the conveyance of real property, not her separate property, requires to be made by her before a judge of the high court, or of a county court, or before a perpetual or special commissioner. Before such an acknowledgment can be received, the judge or commissioner is required to examine her apart from her husband, touching her knowledge of the deed, and to ascertain whether she freely consents. In some British colonies this acknowledgment applies even to separate estates An acknowledgment to the right of the production of deeds of conveyance is an obligation on the vendor, when he retains any portion of the property to which the deeds relate, and is entitled to retain the deeds, to produce them from time to time at the request of the person to whom the acknowledgment is given, to allow copies to be made and to undertake for their safe custody (Conveyancing act, 1881, section 9). The term acknowledgment is, in the United States, applied to the certificate of a public officer that an instrument was acknowledged before him to be the deed or act of the person who executed it. Acknowledgment money was the sum paid in some parts of England by copyhold tenants on the death of the lord of the manor.

**ACKTÉ, AÏNO** (1876–1944), Finnish opera singer, was born at Helsingfors (Helsinki) Aug. 23, 1876. Her studies took place in Paris. In 1897 she made her debut in *Faust* at the Paris Grand Opéra. From 1904 to 1906 she was principal soprano at the Metropolitan Opera house, and from 1907 to 1910 at Covent Garden, London. In 1910 she achieved a great personal triumph at Covent Garden in the title role of Richard Strauss's *Salome*, and was invited by the composer to perform that role in Dresden, Ger , and Paris. In 1911 she founded the annual Finnish Opera festival at Savonlinna, and in 1938 was appointed general manager of the National Opera in Finland. She had a voice of great power, range and flexibility. She died at Helsinki Aug. 8, 1944. (D. E.)

**ACLAND, SIR HENRY WENTWORTH,** BART. (1815–1900), English physician and man of learning, was born near Exeter on Aug. 23, 1815, and died at Oxford on Oct. 16, 1900.

Educated at Harrow and at Christ Church, Oxford, he was elected fellow of All Souls college in 1840, and then studied medicine in London and Edinburgh. Returning to Oxford, he was appointed Lee's reader in anatomy at Christ Church in 1845, and in 1851 Radcliffe librarian and physician to the Radcliffe infirmary. He was regius professor of medicine at Oxford from 1858 to 1894. He was also a curator of the university galleries and of the Bodleian library, and from 1858 to 1887 he represented his university on the General Medical council, serving as president from 1874 to 1887. Acland took a leading part in the revival of the Oxford medical school and in introducing the study of natural science into the university. The establishment of the Oxford university museum, opened in 1861, as a centre for the encouragement of the study of science, especially in relation to medicine, was largely the result of his efforts. "To Henry Acland," said his lifelong friend, John Ruskin, "physiology was an entrusted gospel of which he was the solitary preacher to the heathen" at Oxford. Acland published a study of the outbreak of cholera at Oxford in 1854, together with various pamphlets on sanitary matters, and served on the royal commission on sanitary laws in England and Wales in 1869.

See *Sir Henry Wentworth Acland*, a memoir by J. B. Atlay, with portraits (1903).

**ACME,** the highest point attainable. (Gr. ἀκμή, "point.")

**ACMITE,** or AEGIRITE: *see* PYROXENE.

**ACNE** is a skin disease which has no specific aetiology. It is an inflammation located in and around the hair follicles and sebaceous glands of the skin It is not peculiar to any age or to either sex, although certain age groups are more susceptible; it occurs more frequently at the time of puberty and in early adult life. The disease is related in a measure to diet and to hormonal activity. It may be an accumulation of sebaceous material within the follicles but there also may be superimposed infection with more or less marked inflammation and resultant scar formation. The more severe form is known as acne vulgaris The principles of treatment are based upon a proper diet, personal hygiene and medication as prescribed by a physician. Some drugs, the bromides and iodides, cause acniform lesions

The term acne rosacea is used to describe an inflammation of skin of a chronic nature which is not related to the ordinary form of acne In this disease there is marked redness of the nose and cheeks and sometimes inflammation with suppuration and disfigurement. The treatment is not always satisfactory and should be supervised by someone skilled in the treatment of skin disorders. (*See* also SKIN DISEASES) (F. L. A)

**ACOELOMATA,** a word sometimes used in zoology in contradistinction to Coelomata (*q.v.*) to denote those animals in which no second body cavity (coelom, *q v.*) is present. In the usage adopted by Hyman (1940) the group includes only the Platyhelminthes (*q v.*) and Nemertinea (*see* NEMERTEA).

**ACOEMETI,** an order of Eastern monks who celebrated the divine service without intermission day or night (Gr. ἀκοίμητος, sleepless). This was done by dividing the communities into choirs, which relieved each other by turn in the church. Their first monastery was established on the Euphrates in the beginning of the 5th century. In Constantinople (*c.* 460) the famous monastery of the Studium, founded by the consular Studius, was put in the hands of the Acoemeti and became their chief house, so that they were sometimes called Studites.

BIBLIOGRAPHY.—See Smith and Cheetham, *Dictionary of Christian Antiquities;* Herzog-Hauck, *Realencyklopadie* (3rd ed.); etc.

**ACOLYTE,** the highest of the four minor orders in the Roman Church (Gr. ἀκόλουθος, follower). The office is unknown in the Eastern Church, except among the Armenians who borrowed it from the West. Before the Council of Nicaea (325) it was only found at Rome and Carthage. In 251, Pope Cornelius, in a letter to Fabius of Antioch, mentions among the Roman clergy 42 acolytes, placing them next after the subdeacons (Eusebius, *Hist. Ecc.* vi. 43), giving no hint that the office was a new one. The *Liber Pontificalis* says that Pope Victor (186–197) made *sequentes cleros,* a term which may possibly denote acolytes. While the office was well known in Rome, it was evidently not at first an order through which, as to-day, every candidate to the priesthood must pass. St. Cyprian of Carthage (200?–258) used acolytes to carry his letters, but this seems to be the only place in Africa where they were known. The Irish Church did not know them; and in Spain the Council of Toledo (400) makes no mention of them. The *Statuta Ecclesiae Antiqua,* a Gallican collection for the province of Arles, early 6th century, mentions the acolyte, but does not give, as for the other orders, any form of ordination. The Roman books are silent, and in the *Leonine Sacramentary* and the so-called *Gelasian Mass-book* there is the same silence, though one ms. of the 10th century, given by Muratori, contains a form of ordination of an acolyte. The office is often mentioned in the *Ordines Romani,* but only in *Ordo* VIII. (not earlier than 7th century) do we find a very simple form for admitting an acolyte to his office. The evidence available, therefore, indicates that the acolyte was only a local office, not a necessary step to sacred orders. In England, acolytes first occur, both as office and order, in the Pontifical attributed to Egbert of York (732–766); and Aelfric (1006) in both his pastoral epistle and canons mentions the acolyte. It would seem, then, that the acolyte became an order in the Gallican Church first, and afterwards found its way as such into the Roman books before the fusion of the two rites under Charlemagne.

The duties of the acolyte, as given in the Roman Pontifical, are identical with those mentioned in the *Statuta Ecclesiae Antiqua* of Arles: "to carry the candlesticks, to light the lamps of the church, to administer wine and water for the Eucharist" The *Ordines Romani* divides the acolytes into *Palatini,* who served the pope at the Lateran palace, *Stationarii,* who served at churches where there was a "station," and *Regionarii,* or those attached directly to the regions; and gives us a glimpse of their duties. When the pope rode in procession to the station an acolyte walked before him, bearing the holy chrism; and at the church seven acolytes with candles went before him to the altar, while two others, bearing the vessel that contained a consecrated Host, presented it for his adoration. At the communion the acolytes received in linen bags the consecrated Hosts to carry to the assisting priests. The official dress of the acolyte (*Ordo* V.) was a close-fitting linen garment (*camisia*), a napkin hanging from the left side, a white tunic, a stole (*orarium*) and a chasuble (*planeta*) which he took off when he sang on the steps of the *ambo.*

At the present day the duties of acolytes are now performed, almost everywhere, by laymen. The office has been revived unofficially in the Church of England, as a result of the Tractarian movement.

*See* Morin, *Commentarius in sacris Ecclesiae ordinationibus,* ii. p. 209, iii. p. 152 (Antwerp, 1685); Martène, *De Antiquis Ecclesiae ritibus,* ii. pp 47 and 86 (Antwerp, 1739); Mabillon, *Musaeum Italicum II* for the *Ordines Romani;* Muratori, *Liturgia Romana Vetus;* Cabrol, *Dictionnaire d'archéologie chrétienne et de liturgie,* vol. i col. 348–536.

**ACOMA,** a tribe and town of the Pueblo Indians in New Mexico, forming an isolated western settlement of the Keres stock. The town is strikingly situated on a mesa rising 350ft sheer above the surrounding plain, in which lie the Pueblo farmlands at a distance of some miles. It is reputed to be the oldest inhabited settlement in the United States, a distinction which, however, may be challenged by Zuñi and Oraibi. Discovered by Coronado's army in 1540, Acoma surprised and defeated a Spanish detachment in 1598, lost heavily in its subjugation next year, received a permanent mission early in the 17th century, rebelled with the other Pueblos in 1680, but was reconquered. The original population was perhaps 1,000, the present one is about 500

**ACOMINATUS** (AKOMINATOS), **MICHAEL** (*c.* 1140–1220), Byzantine writer and ecclesiastic, was born at Chonae (the ancient Colossae). He studied at Constantinople, and about 1175 was appointed archbishop of Athens. After the capture of Constantinople by the Franks and the establishment of the Latin empire (1204), he retired to the island of Ceos, where he died. He wrote homilies, speeches and poems which, with his correspondence, throw considerable light upon the miserable condition of Attica and Athens at the time. His memorial to Alexis III. Angelus on the abuses of Byzantine administration, the poetical lament over the degeneracy of Athens, and the monodes on his brother Nicetas and Eustathius, archbishop of Thessalonica, deserve special mention.

BIBLIOGRAPHY.—Edition of his works by S. Lambros (1879–80); Migne, *Patrologia Graeca,* cxl.; *see* also A. Ellissen, *Michael Akominatos* (1846), containing several pieces with German translation; F. Gregorovius, *Geschichte der Stadt Athen im Mittelalter,* i. (1889); G. Finlay, *History of Greece,* iv. p. 133–134, (1877).

His younger brother, NICETAS (Niketas), sometimes called CHONIATES, who accompanied him to Constantinople, held several appointments under the Angelus emperors (amongst them that of "great logothete" or chancellor) and was governor of the "theme" of Philippopolis at a critical period. After the fall of Constantinople he fled to Nicaea, where he settled at the court of the emperor Theodorus Lascaris, and devoted himself to literature. He died between 1210 and 1220. His chief work is his *History,* in 21 books, of the period from 1180 to 1206. In spite of its florid style, it is of considerable value as a record (on the whole impartial) of events of which he was either an eye-witness or had heard at first hand. Its most interesting portion is the description of the capture of Constantinople. The little treatise *On the Statues* destroyed by the Latins (perhaps, as we have it, altered by a later writer), is of special interest to the archaeologist. His dogmatic work (Θησαυρὸς Ὀρθοδοξίας, *Thesaurus Orthodoxae Fidei*), extant in a complete form in ms, is one of the

chief authorities for the heresies of the 12th century.

BIBLIOGRAPHY.—*History,* editio princeps, H. Wolf (1557); and in the Bonn *Corpus Scriptorum Hist. Byz.,* 1st ed., Bekker (1835); Rhetorical Pieces in C. Sathas, Μεσαιωνική βιβλιοθήκη, i. (1872); *Thesaurus* in Migne, *Patrologia Graeca,* cxxxix., cvi.; *see* also C. A. Sainte-Beuve, "Geoffroy de Villehardouin" in *Causeries du Lundi,* ix.; S. Reinach, "La fin de l'empire grec," in *Revue Archéologique* (1888); C. Neumann, *Griechische Geschichte im 12 Jahrhundert* (1888), Gibbon, *Decline and Fall,* ch. lx; and (for both Michael and Nicetas) C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

**ACONCAGUA,** a province in the northern part of central Chile, bounded on the north by Coquimbo, east by Argentina, south by Santiago and Valparaiso, and west by the Pacific. In 1928, at which time the province annexed Valparaiso, its area was 7,180 sq.mi. During the '30s, however, the geographical limits of many of the provinces were redefined, with the result that Valparaiso was again made a separate province, the territory of Coquimbo was expanded, and the area of Aconcagua was reduced to 3,940 sq mi.; population (1940 census), 118,049. The surface of the land is for the most part mountainous, interrupted by broad valleys, including the northern reaches of the famous Central valley of Chile, which lies between the coastal ranges and the piedmont alluvial slopes of the Andes. The major valleys, however, are transverse and include those of the Aconcagua and Ligua rivers, together with those of their tributaries. Climatically the province lies in a transitional zone between the arid northern part of Chile and the subhumid central part. The annual rainfall, which amounts to but a few inches, coincides with the winter season; summers are rainless, but the drought is mitigated somewhat along the coast by the presence of persistent fogs. Inland the skies are clear in summer and the temperatures are high. The natural vegetation (cacti, scrub and grasses) resembles closely the *chaparral* of the southwestern Pacific area of the United States, or the *maqui* of Mediterranean Europe. The valleys are highly fertile, and where irrigation is employed crops of alfalfa, wine grapes, fruits and vegetables are produced in abundance. San Felipe, capital of the province, is on the Río Aconcagua in a rich agricultural centre, connected by rail (Transandine railway) with Valparaiso (80 mi.), and by rail and car with Mendoza, Argentina.

**ACONCAGUA,** an extinct volcano in the southern Andes with a height of 22,835 ft., usually regarded as the loftiest mountain in America. It is situated on the boundary line between Chile and Argentina in 32° 39′ S. and 70° 1′ W. On its southern slope is the source of the Aconcagua river which flows westerly to the Pacific ocean through a course of about 200 miles. The summit of Aconcagua was first scaled in 1897 by Vines and Zurbriggen of the FitzGerald expedition.

BIBLIOGRAPHY.—Edward Ambrose FitzGerald, "Exploration on and around Aconcagua," *Geographic Journal,* vol xii, pp 469–494 (1898) and "The First Ascent of Aconcagua," *McClure's Magazine,* vol. xi (1898); Sir William Martin Conway, *Aconcagua and Tierra del Fuego* (1902).

**ACONCIO, GIACOMO** (1492–1566?), pioneer of religious toleration, was one of the Italians, like Peter Martyr and Bernardino Ochino, who repudiated Roman Catholic doctrine and ultimately found refuge in England, where he worked as an engineer on various public works. Before reaching England he had published a treatise on the methods of investigation, *De Methodo, hoc est, de recte investigandarum tradendarumque Scientiarum ratione* (1558); and his critical spirit placed him outside all the recognized religious societies of his time.

On his arrival in London he had joined the Dutch Reformed Church in Austin Friars, but he was "infected with Anabaptistical and Arian opinions" and was excluded from the sacrament by Grindal, bishop of London. The real nature of his heterodoxy is revealed in his *Stratagemata Satanae* (1565). The "stratagems of Satan" are the dogmatic creeds which rent the Christian church. Aconcio sought to reduce dogma to a minimum in the hope of finding a common denominator for the various creeds.

BIBLIOGRAPHY.—*See* Gough's *Index to Parker Soc. Publ.;* Strype's *Grindal,* pp 62, 66; Bayle's *Dictionnaire;* G. Tiraboschi, *Storia della lett. Italiana* (1805–13); *Österreichisches Biogr. Lexikon; Nouvelle biogr. générale; Dict. Nat. Biogr.*

**ACONITE** (*Aconitum*), a genus of plants belonging to the Ranunculaceae, the buttercup family, commonly known as aconite, monkshood or wolfsbane, and embracing about 60 species, chiefly natives of the mountainous parts of the northern hemisphere. They are distinguished by having one of the five blue or yellow coloured sepals (the posterior one) in the form of a helmet; hence the English name monkshood. Two of the petals placed under the hood of the calyx are supported on long stalks, and have a hollow spur at their apex, containing honey. They are handsome plants, the tall stem being crowned by racemes of showy flowers. *Aconitum napellus,* common monkshood, is a doubtful native of Britain, and is of therapeutic and toxicological importance. Its roots have occasionally been mistaken for horse-radish. The aconite has a short underground stem, from which dark-coloured tapering roots descend. The crown or upper portion of the root gives rise to new plants. When put to the lip, the juice of the aconite root produces a feeling of numbness and tingling. The horse-radish root, which belongs to the family Cruciferae, is much longer than that of the aconite, and it is not tapering; its colour is yellowish, and the top of the root has the remains of the leaves on it.

Many species of aconite are cultivated in gardens, some having blue and others yellow flowers. *Aconitum lycoctonum,* wolfsbane, is a yellow-flowered species common on the Alps of Switzerland. The roots of *Aconitum ferox* supply the famous Indian (Nepal) poison called bikh, bish or nabee. It contains considerable quantities of the alkaloid pseudaconitine, which is the most deadly poison known. *Aconitum palmatum* yields another of the celebrated bikh poisons. The root of *Aconitum luridum,* of the Himalayas, is said to be as virulent as that of *A. ferox* or *A napellus.* As garden plants the aconites are very ornamental, hardy perennials. They thrive well in any ordinary garden soil, and will grow beneath the shade of trees. They are easily propagated by divisions of the root or by seeds.

**Chemistry.**—The active principle of *Aconitum napellus* is the alkaloid aconitine, first examined by P. L. Geiger and Hesse (*Ann,* 1834, 7, p. 267). Alder Wright and A. P. Luff obtained apoaconitine, aconine and benzoic acid by hydrolysis; while, in 1892, C. Ehrenberg and A. Purfürst (*Journ. Prat. Chem,* 1892, 45, p. 604) observed acetic acid as a hydrolytic product. This, and allied alkaloids, have formed the subject of many investigations by Wyndham Dunstan and his pupils in England, and by Martin Freund and Paul Beck in Berlin. But their constitution is not yet solved, there even being some divergence of opinion as to their empirical formulae. Aconitine ($C_{33}H_{45}NO_{12}$, according to Dunstan; $C_{34}H_{47}NO_{11}$, according to Freund) is a crystalline base, soluble in alcohol, but very sparingly in water; its alcoholic solution is dextrorotatory, but its salts are laevorotatory. When heated it loses water and forms pyraconitine. Hydrolysis gives acetic acid and benzaconine, the chief constituent of the alkaloids picraconitine and napelline; further hydrolysis give aconine. Pseudaconitine, obtained from *Aconitum ferox,* gives on hydrolysis acetic acid and veratryl-pseudaconine, the latter of which suffers further hydrolysis to veratric acid and pseudaconine. Japaconitine, obtained from the Japanese aconites, known locally as "kuza-uzu," hydrolyses to japbenzaconine, which further breaks down to benzoic acid and japaconine. Other related alkaloids are lycaconitine and myoctonine which occur in wolfsbane, *Aconitum lycoctonum.* The usual test for solutions of aconitine consists in slight acidulation with acetic acid and addition of potassium permanganate, which causes the formation of a red crystalline precipitate. In 1905, Dunstan and his collaborators discovered two new aconite alkaloids, indaconitine in "mohri" (*Aconitum chasmanthum,* Stapf), and bikhaconitine in "bikh" (*Aconitum spicatum*); he also proposes to classify these alkaloids according to whether they yield benzoic or veratric acid on hydrolysis (*Jour. Chem. Soc.,* 1905, 87, pp. 1620, 1650).

From the root of *Aconitum napellus* are prepared a liniment and a tincture. The dose of the latter (Brit. Pharmacop.) is of importance as being exceptionally small, for it is not advisable to give more than at most five drops at a time. The official preparation is an ointment which contains one part of the alkaloid

in fifty It must be used with extreme care, and in small quantities, and it must not be used at all where cuts or cracks are present in the skin.

**Pharmacology of Aconite and Aconitine.**—Aconite first stimulates and later paralyses the nerves of pain, touch and temperature, if applied to the skin, broken or unbroken, or to a mucous membrane, the initial tingling therefore gives place to a long-continued anaesthetic action. Taken internally aconite acts very notably on the circulation, the respiration and the nervous system. The pulse is slowed, the number of beats per minute being actually reduced, under considerable doses, to 40, or even 30, per minute. The blood-pressure synchronously falls, and the heart is arrested in diastole. Immediately before arrest the heart may beat much faster than normally, though with extreme irregularity, and in the lower animals the auricles may be observed occasionally to miss a beat, as in poisoning by veratrine and colchicum. The action of aconitine on the circulation is due to an initial stimulation of the cardio-inhibitory centre in the medulla oblongata (at the root of the vagus nerves), and later to a directly toxic influence on the nerve-ganglia and muscular fibres of the heart itself. The fall in blood-pressure is not due to any direct influence on the vessels. The respiration becomes slower owing to a paralytic action on the respiratory centre and, in warm-blooded animals, death is due to this action, the respiration being arrested before the action of the heart. Aconite further depresses the activity of all nerve-terminals, the sensory being affected before the motor. In small doses it therefore tends to relieve pain, if this be present. The activity of the spinal cord is similarly depressed. The pupil is at first contracted and afterwards dilated. The cerebrum is totally unaffected by aconite, consciousness and the intelligence remaining normal to the last. The antipyretic action which considerable doses of aconite display is not specific, but is the result of its influence on the circulation and respiration and of its slight diaphoretic action.

**Therapeutics.**—The indications for its employment are limited, but definite. It is of undoubted value as a local anodyne in sciatica and neuralgia, especially in ordinary facial or trigeminal neuralgia. The best method of application is by rubbing in a small quantity of the aconitine ointment until numbness is felt, but the costliness of this preparation causes the use of the aconite liniment to be commonly resorted to. This should be painted on the affected part with a camel's hair brush dipped in chloroform, which facilitates the absorption of the alkaloid. Aconite is indicated for internal administration whenever it is desirable to depress the action of the heart in the course of a fever Formerly used in every fever, and even in the septic states that constantly followed surgical operation in the pre-Listerian epoch, aconite is now employed only in the earliest stage of the less serious fevers, such as acute tonsillitis, bronchitis and, notably, laryngitis. The extreme pain and rapid swelling of the vocal cords—with threatened obstruction to the respiration—that characterize acute laryngitis may often be relieved by the sedative action of this drug upon the circulation. In order to reduce the pulse to its normal rate in these cases, without at the same time lessening the power of the heart, the drug must be given in doses of about two minims of the tincture every half-hour and then every hour until the pulse falls to the normal rate. Thereafter the drug must be discontinued. It is probably never right to give aconite in doses much larger than that named. There is one condition of the heart itself in which aconite is sometimes useful. While absolutely contraindicated in all cases of valvular disease, it is of value in cases of cardiac hypertrophy with over-action. But the practitioner must be assured that neither valvular lesion nor degeneration of the myocardium is present.

**Toxicology.**—In a few minutes after the introduction of a poisonous dose of aconite, marked symptoms supervene. The initial signs of poisoning are referable to the alimentary canal. There is a sensation of burning, tingling and numbness in the mouth, and of burning in the abdomen Death usually supervenes before a numbing effect on the intestine can be observed. After about an hour there is severe vomiting. Much motor weakness and cutaneous sensations similar to those above described soon follow. The pulse and respiration steadily fail, death occurring from asphyxia. As in strychnine poisoning, the patient is conscious and clear-minded to the last. The only post-mortem signs are those of asphyxia. The treatment is to empty the stomach by tube or by a non-depressant emetic. The physiological antidotes are atropine and digitalin or strophanthin, which may be injected subcutaneously in maximal doses. Alcohol, strychnine and warmth must also be employed.

**ACONITINE:** *see* ACONITE.

**ACONTIUS,** in Greek legend, a beautiful youth of the island of Ceos. During the festival of Artemis, at Delos, Acontius saw and loved Cydippe, a well-born Athenian maiden. He wrote on an apple the words, "I swear to wed Acontius" and threw it at her feet. She picked it up, and mechanically read the words aloud, thus binding herself by an oath. Therefore, although she was betrothed more than once, she always fell ill before the wedding took place. The Delphic oracle at last explained the matter, and she married Acontius.

(Callimachus, *Aitia,* III, 1 Mair; *see* his notes [p. 204 of the Loeb ed.] for other authorities.)

**ACORN,** the fruit of the oaks (*Quercus*) and tanbarks (*Lithocarpus*); a word also used, by analogy with the shape, in nautical phraseology for a piece of wood keeping the vane on the mast-head.

**ACORN SHELLS,** popular English name given to sessile forms of barnacles (*q.v.*) common on rocks, piers, etc., on sea coasts; in America often called rock-barnacles. (*See* CIRRIPEDIA.)

**ACORUS CALAMUS,** sweet-sedge or sweet-flag, a marsh plant which shares with the cuckoo pint (*Arum*) the representation in Britain of the family Araceae and is found throughout the north temperate zone. The name is derived from *acorus,* Gr. ἄκορος, the classical name for the plant. It was the *Calamus aromaticus* of the mediaeval druggists and perhaps of the ancients, though the latter has been referred by some to citronella grass, *Cymbopogon nardus.*

The plant is a herbaceous perennial with a long, branched rootstock creeping through the mud, about ¾ inch thick, with short joints and large brownish leaf-scars.

The leaves are tufted, flat, sword-like, sweet-scented, 3 or 4 ft. long and about an inch wide, closely arranged in two rows as in the true Flag (*Iris*); the tall flowering stems (scapes), which very much resemble the leaves, bear an apparently lateral, blunt, tapering, spike-like cluster (spadix) of densely packed, very small flowers.

A long leaf (spathe) borne immediately below the cluster forms an apparent continuation of the scape, though really a lateral outgrowth from it, the spadix being terminal. The rootstock yields the drug calamus, and a variegated form is cultivated for ornament.

**ACOSMISM.** This term was coined by Fichte and Hegel on the model of the term atheism. According to the ordinary view, reality consists of God and a world (cosmos) of finite objects usually conceived as having been created by Him and made to conform to certain laws. Now atheism is the theory which denies the existence of God, and so identifies reality with a godless world of objects and events which exist of themselves and have an inherent order of their own. Acosmism is the contrary view that denies the independent reality of a world of finite objects and events, and regards God as the sole ultimate reality. In accordance with the common practice of denouncing anybody as an atheist whose conception of God was different from theirs, Spinoza was generally described as an atheist by his contemporaries and others Hegel protested against the injustice of this. Spinoza, he said, was so far from denying the existence of God that he acknowledged no other ultimate reality—so far from being an atheist he was an acosmist. Fichte similarly applied the term to himself in reply to similar accusations. The term acosmism has since been applied also to philosophies like those of the Vedanta, of Buddhism, and of Schopenhauer. Apart from its polemical uses the term acosmism, with its suggestion of an illusory world, is not a happy equivalent of the term pantheism Strictly speaking, a pantheism like that of Spinoza no more denies the reality of

the world than it denies the reality of God. It simply identifies the universe with God, and for that very reason regards the universe all the more as a world of order, a real *cosmos*. Moreover, there is an important sense in which pantheism is essentially *cosmic*, namely, in the sense that it regards man from the standpoint of the universe, instead of regarding the universe from the point of view of man (*see* ANTHROPOCENTRIC PHILOSOPHY). "Acosmism" is therefore not only an inadequate, but also a misleading description of pantheism.

**ACOSTA, JOAQUIN** (*c.* 1795–1852), Colombian historian and soldier, was an officer in Bolivar's army, and a member of congress. He travelled in Colombia and in Spain, collecting material for his *Compendio histórico del descubrimiento y colonización de la Nueva Granada*, which was published in Paris in 1848

**ACOSTA, JOSÉ DE** (1539?–1600), Spanish author, was born at Medina del Campo about the year 1539. He joined the Jesuits in 1551, and in 1571 was sent as a missionary to Peru; he acted as provincial of his Order from 1576 to 1581, was appointed theological adviser to the Council of Lima in 1582, and in 1583 published a catechism in Quichua and Aymara—the first book printed in Peru In 1598 he became rector of the Jesuit college at Salamanca, where he died on Feb. 15, 1600. His treatise, *De natura novi orbis libri duo* (Salamanca, 1588–89), may be regarded as the preliminary draft of his celebrated *Historia natural y moral de las Indias* (Seville, 1590), which was speedily translated into Italian (1596), French (1597), Dutch (1598), German (1601), Latin (1602), and English (1604). The *Historia* is in three sections. books I and II deal with generalities; books III and IV with the physical geography and natural history of Mexico and Peru; books V, VI, and VII, with the religious and political institutions of the aborigines. Apart from his sophistical defense of Spanish colonial policy, de Acosta deserves high praise as an acute and diligent observer. Among his other publications is *De procuranda salute Indorum libri sex* (Salamanca, 1588).

BIBLIOGRAPHY.—Edward Grimston's translation of the *Historia* reprinted (1880) for the Hakluyt Society, with introduction and notes by Sir Clements R. Markham; C Sommervogel, *Bibliothèque de la Compagnie de Jésus, Première Partie* (1890), vol. i, col. 31–42; José R. Carricido, *El P. José de Acosta y su importancia en la literatura científica española* (1899).

**ACOSTA, URIEL** (d. 1647), Jewish author, was born at Oporto near the end of the 16th century. Educated in the Roman Catholic faith, he was received into the synagogue at Amsterdam and exchanged his baptismal name of Gabriel for Uriel. His wayward disposition, however, found no satisfaction in Judaism. He was twice excommunicated, and twice readmitted to the synagogue. In his autobiography, *Exemplar humanae vitae*, printed in 1687 and again in 1847, Acosta declared his hostility both to Christianity and Judaism, but spoke most bitterly of Judaism. He committed suicide in 1647. The story of Acosta's life provided K. F. Gutzkow with the material of the tragedy of *Uriel Acosta* (1847).

**ACOUSTICS OF BUILDINGS** is that part of the science of sound which deals with the production, transmission and absorption of sound in buildings. The primary use of the findings of this science is in the acoustical design of buildings to minimize noise, that is, unwanted sounds, and to transmit wanted sounds to listeners undistorted and with sufficient intensity. Attempts to attain these ideals involve a consideration of the noise to be controlled, the reduction of mechanical disturbances, the soundproofing of building constructions and the acoustical adjustment of rooms for listening. The following discussion will take up these topics in the order named, assuming the statements of the general principles of acoustics and hearing, as given in the articles on SOUND and HEARING.

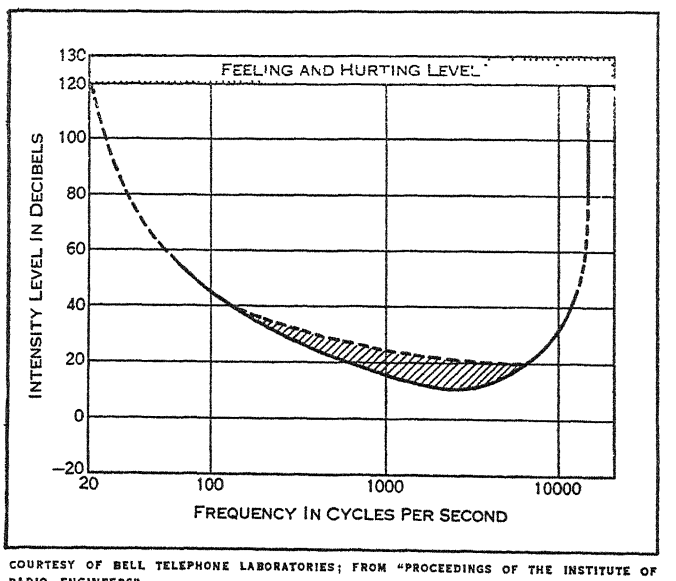
**Noise.**—Sources of noise, which may be either inside or outside buildings, are such things as typewriters, radios, auto horns, whistles and talking; these sources create sounds that travel in the air. Other sources set up vibrations in the structure of the building, either directly, as when machines are attached to the structure, or indirectly, as when vehicles or drilling devices set up vibrations in the ground which are transmitted into the building. To protect listeners in the building, it is necessary to interpose discontinuities in the paths of these disturbances. Table I shows that the range of sounds, which must be tolerated by the ear, is enormous, extending from a "threshold" value of one arbitrary unit for a faint sound that can just be detected to 1,000,000,000,000 units for a very loud sound.

TABLE I.—*Intensity of Sound*

| Units | Decibels | Type of Noise |
|---|---|---|
| 1,000,000,000,000 | 120 | |
| 100,000,000,000 | 110 | Aeroplane engine |
| 10,000,000,000 | 100 | |
| 1,000,000,000 | 90 | Heavy traffic, pneumatic drill |
| 100,000,000 | 80 | |
| 10,000,000 | 70 | Noisy office, telephone conversation, ordinary traffic |
| 1,000,000 | 60 | |
| 100,000 | 50 | Average office |
| 10,000 | 40 | Ordinary conversation |
| 1,000 | 30 | Quiet home, quiet conversation |
| 100 | 20 | |
| 10 | 10 | Rustle of leaves, whisper |
| 1 | 0 | |

Smaller numbers to express this vast range have been developed by using the *decibel* unit, the number of decibels between two intensity levels being obtained by taking ten times the logarithm of the ratio of the intensities. Although the tolerable range is very great, the absolute energy of sounds is very small, an average voice having only about one-millionth of the energy needed to operate an ordinary electric lamp

**Hearing.**—Since any control of sound in buildings is made for the convenience and comfort of the occupants, the acoustician should consider the performance of the ear and the phenomena of hearing when making any adjustments. Extensive experiments in this connection have been made by the Bell Telephone Laboratories because of the importance of speech and hearing in telephony. Harvey Fletcher published data obtained by young persons with normal hearing, showing the frequency and intensity limits of sounds that can be perceived without discomfort (*Speech and Hearing*, 1929). In 1942 Fletcher published an important article (*Proc. Inst. Radio Eng.*, June, 1942) based on (1) Measurements of the threshold and frequency limits of more than 500,000 people at the New York and San Francisco world's fairs in 1940; (2) Measurements of the discomfort level of sound; (3) Measurements of room noise in a wide variety of locations, and (4) Measurements of the frequency limits and the maximum and minimum levels of speech, orchestral music, and the various instruments of the orchestra. Some of the results of the first two sets of measurements are shown in Fig. 1, which gives the limits of hearing of the average listener (50% of the listeners tested at the world's fairs) under quiet condi-




COURTESY OF BELL TELEPHONE LABORATORIES; FROM "PROCEEDINGS OF THE INSTITUTE OF RADIO ENGINEERS"

FIG. 1.—LIMITS OF HEARING AND ROOM NOISE

tions. The lower curve shows the hearing threshold for pure tones for the average listener, while the line of 120 decibels gives the upper limit, above which sounds become uncomfortably

loud and even harmful. The area enclosed between these two limits, called the average auditory sensation area, gives the range of sounds as to frequency and intensity which can be heard comfortably by the average listener; it therefore determines the range within which noise is audible and also the range within which wanted sounds must lie if they are to be heard. Any noise which is present in sufficient intensity and which lies above the threshold curve, encroaches and limits the useful auditory sensation area. The shaded area indicates the extent, according to Fletcher, to which noise in average residences and average motion-picture theatres reduces the area. In the average business office, the encroachment is approximately 15 decibels more, and in the average factory location, it is 35 decibels more. Guided by the information in Fig 1, the acoustician is concerned to reduce noise so as to keep its encroachment as small as possible and, in auditoriums, to try to push it below the lower curve.

**Vibrations** that are due to machinery and near-by street traffic can enter a building structure and cause floors to vibrate and create a rattling of loose windows, doors and other constructions. These disturbances annoy workers and reduce their efficiency. The trouble may be reduced by using "quiet-running" motors and rubber-tired vehicles. Machines should be dynamically balanced and should rest on resilient supports that "give" somewhat under the load—the popular notion that a sheet of cork under the machine will control the vibrations is misleading For low-frequency machines, the supports should be damped; for high frequencies, the supports should be elastic without damping. These details can be calculated prior to the installation of the machines (Timoshenko, *Vibrations Problems in Engineering;* J. P. den Hartog, *Mechanical Vibrations;* Slocum, *Noise and Vibration Engineering*)

**Soundproofing** involves the use of special constructions that will reduce the transmission of noise. Numerical values of the reduction of sound by partitions are obtained experimentally. Measurements are taken for the sound incident on [illegible] partition and also for the reduced sound that emerges from the other side For example, if an incident sound of 1,000,000 units intensity is reduced to 1,000 units by the partition, the decibel loss is 30 db ($10 \times \log 1{,}000{,}000/1{,}000 = 30$ db.). This means that a loud radio sound of 80 db. level in one room would be reduced 30 db. by the partition and would have only a 50 db. level in the adjoining room. Table II exhibits a few data chosen from the extensive tables published by Vern O. Knudsen (*Architectural Acoustics,* 1932), Paul Earls Sabine (*Acoustics and Architecture,* 1932) and the National Bureau of Standards (*Report BMS-17,* 1939; *Supplement to Report BMS-17,* 1940).

TABLE II.—*Effects of Various Partitions in Soundproofing*

| Partition | Weight | Sound reduction |
|---|---|---|
| Heavy wrapping paper | .016 lb per sq ft. | 2 0 db. |
| One-inch hairfelt | .75 " " " " | 5 8 " |
| One-half-inch fibre board | 75 " " " " | 19 0 " |
| Light door | | 22 0 " |
| One-quarter-inch plate glass | 3.5 " " " " | 30 0 " |
| [illegible] tile, plastered | 29 " " " " | 40 0 " |
| Four-inch wood stud, " | 15 6 " " " " | 42 0 " |
| Concrete wall, " | 26 " " " " | 42 0 " |
| Eight-inch brick wall | 87 " " " " | 50 0 " |

Inspection of the results shows that the door and the glass (window) transmit more sound than the walls do, so that it is a mistake to install highly-insulating partitions unless double doors and windows are also used This last statement is strikingly illustrated by the following example (Bureau of Standards, *ibid* p. 9): Consider a brick building containing a single room, with plastered brick walls, 8 in. thick, a plastered cement slab roof, 6 in. thick, several windows and a door. Inspection of the data shows that the windows, with only 150 sq.ft. area, transmit 2,400 units of sound energy out of the total of 2,575 units, the door transmits 67 units, while the roof and the walls, with much larger areas, transmit only 60 and 48 units respectively.

TABLE III.—*Relative Sound Transmissions of Parts of a Brick Building*

| Material | Area | Relative transmission |
|---|---|---|
| Brick walls | 1,200 sq ft. | 48 units |
| Cement roof | 600 " " | 60 " |
| Windows | 150 " " | 2,400 " |
| Door | 21 " " | 67 " |
| Total | | 2,575 |

Double partitions stop more sound than single partitions, particularly if the two elements are separated by an air space, which should be 4 in. or more thick [illegible] the air space with wood studding or packing it with sawdust or similar materials is usually detrimental. Any openings in the continuity of a wall for ventilators or pipes should be controlled, since sound passes easily through an air passage. Ventilating ducts are lined on the inside with [illegible] materials, according to definite rules formulated by [illegible] engineers Floors are more difficult to insulate [illegible] impact sounds of footsteps on ordinary floors or masonry floors can be heard almost as loudly in the room below as in the room above the floor. A floating floor on masonry with a suspended [illegible] below gave the best results. (Bureau of Standards, *ibid* p. 7 [illegible], the controlling qualities of a partition that determine its insulation are its weight and its possibility of vibration. A brick wall, because of its weight and small vibration, makes one of the best insulators, but it is too heavy and bulky for extensive use, so that many lighter and smaller partitions have been developed. These thinner units are likely to vibrate under the impact of sound and will thus transmit certain low frequencies so that they are undesirable for broadcasting rooms and [illegible] where great insulation is needed. An approximate estimation of the effect on hearing by reduction of sound is given as follows:

"With an average reduction factor of 25 db, normal speech can be understood quite easily and distinctly through the partition.

"With an average reduction factor of 30 db., loud speech can be understood fairly well if conditions are quiet.

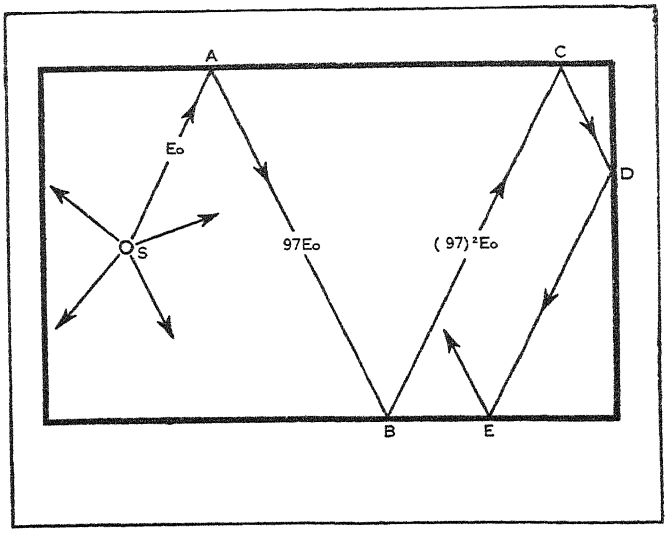
"With an average reduction factor of 35 db., loud speech is audible, but not easily intelligible under quiet conditions

"With an average reduction factor of 40 db, normal speech is not audible, loud speech can be faintly heard but not easily understood, and for all practical purposes the partition can be considered soundproof. Separating [illegible] apartments should have a factor of about 40

"Greater insulation than 40 db. is needed to reduce loud piano and radio sounds" (Acoustical Materials Association).

It has been shown in an important paper on loudness that, except for low frequencies, a reduction of 9 decibels makes a sound appear approximately half as loud. (Fletcher and Munson, *Jour. Acous. Soc. Amer*, 9, p. 1, 1937.)

**Acoustics of Rooms** become satisfactory when the noise level is reduced, as explained in Fig 1, and adjustments are made to insure the effective production and reception of wanted sounds Fig. 2 shows how sound starts from a source S, and proceeds outward in spherical waves with a rapid velocity of about 1,100 ft. per sec On striking the boundaries of the room, sound waves are reflected, losing a little energy in the process, then they proceed to another boundary for another reflection, and so on until they become inaudible As a numerical example consider a room with a volume of 100,000 cu ft. that is [illegible] by 20,000 sq ft of hard plaster walls and a wooden floor




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FIG. 2.—REFLECTION OF SOUND WAVES IN A ROOM

that absorb an average of 3% of the incident sound energy at each reflection Calculations show that while the sound decreases in energy to one-millionth of its initial value, it will make 461 reflections, and will travel a distance of 9,220 ft. in a "time of reverberation" of 8.22 sec. (Watson, *Acoustics of Buildings,* p. 32, 1941.) Under these conditions, the hearing will be very unsatisfactory. Before the first word of a speech dies out, several other words will have been uttered that will mix with the earlier ones, thus producing a confusion that

makes it almost hopeless for the auditor to understand what is said. The obvious correction is to make the boundaries of the room more absorptive so that the sounds will die out quicker.

When a sound persists for some time in a room, such as a tone generated by a musical instrument, the energy builds up in a very short time to a steady state in which the energy emitted per second by the instrument is just balanced by the energy absorbed in the same time by the boundaries of the room. Many reflections are then taking place, with the result that the room is filled with sound waves proceeding in every direction. While these reflections beneficially build up the loudness somewhat, they unfortunately create the usual acoustical defects found in rooms—resonances, echoes, reverberation and distortion.

**Resonances.**—The random action of sound just described is not in exact accord with the actual conditions. It is found that portions of the sound proceeding in certain directions are likely to be amplified so as to produce resonances, as, for example, in a bath room which has highly reflecting surfaces. The frequencies, $f$, of these resonances, or 'normal modes,' is as follows.

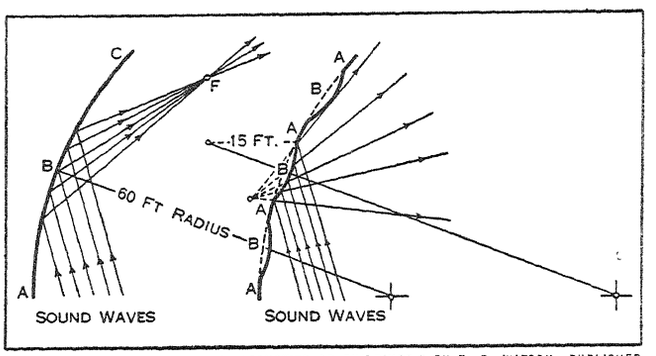
$$f = \frac{c}{2}\left[\left(\frac{p}{l}\right)^2 + \left(\frac{q}{w}\right)^2 + \left(\frac{r}{h}\right)^2\right]^{1/2}$$

where $p$, $q$, and $r$ are numbers, 0, 1, 2, 3, etc., for different modes, $l$, $w$, and $h$ are respectively the length, width, and height of the room, and $c$ is the velocity of sound. As an example, if $q=0$, $r=0$, then $f=cp/(2l)$, which gives the normal vibrations parallel to the length of the room. If the length of the room is 10 feet, the velocity of sound 1,120 feet per second, and $p=1$, then $f=1{,}120/(2\times10)=56$ cycles per second. For $p=2$, $f=112$ cycles per second, etc. Similar vibrations can be set up parallel to the width and height of the room. Diagonal vibrations can also take place, as, for example, when $p=1$, $q=1$, and $r=0$" (*Acoustics of Buildings*, by F. R. Watson).

Knudsen states that resonances in large rooms can usually be neglected for sounds with a frequency above 100 cycles per sec., because the lowest normal modes are in the subaudible range of hearing. (*Reviews of Modern Physics*, 6, p. 9, 1934.) For smaller rooms, such as those used for broadcasting or for phonograph recording, where distortion of sound must be avoided, the resonances must be reduced. An effective means of correction is to install convex cylindrical segments in the walls and ceiling that diverge the reflected sound and produce a more uniform distribution in the room. It is also necessary to install sound-absorbing materials, such as a lined carpet, and absorbing panels of irregular shape which are located in selected positions. To avoid coincidences of resonances set up between the three sets of parallel walls, the dimensions of the room should be related by an inharmonic ratio, such as $\sqrt[3]{2}$ power, as, for example, $12.5\times20\times32$ ft. (J. E. Volkmann, *Jour. Acous. Soc. Amer.*, 13, p. 240, 1942; C. P. Boner, *ibid*, 13, p. 244.)

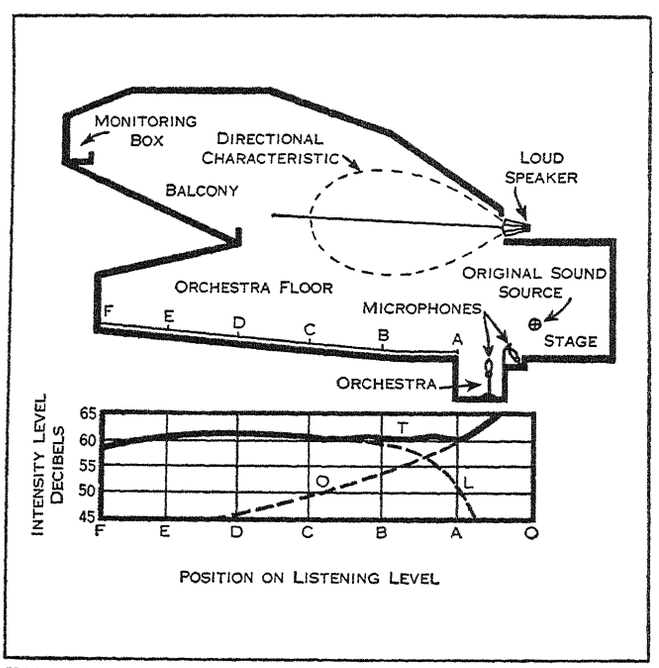
**Public Address System.**—Another modification of the random action of sound is brought about by the use of a public-address, or sound-amplifying, system. Thus, instead of the confused mass of weak sound of a speaker's voice that spreads out in all directions, the loud-speaker emits a powerful beam of sound that covers the area occupied by the audience. There is some reflection from the rear walls so that the room is filled with diffused sound.

The use of public-address systems introduces a new problem in acoustical control. That is, while a large part of the energy of the beam of sound from the loud-speaker is absorbed by the audience (clothing and seats), it is necessary to make provision for the drastic reduction of the reflection from the rear walls, if echoes and other sound concentrations are to be avoided. This control is brought about by designing the rear walls so that regular reflection and concentration of sound are reduced, and by installing special sound-absorbing constructions.



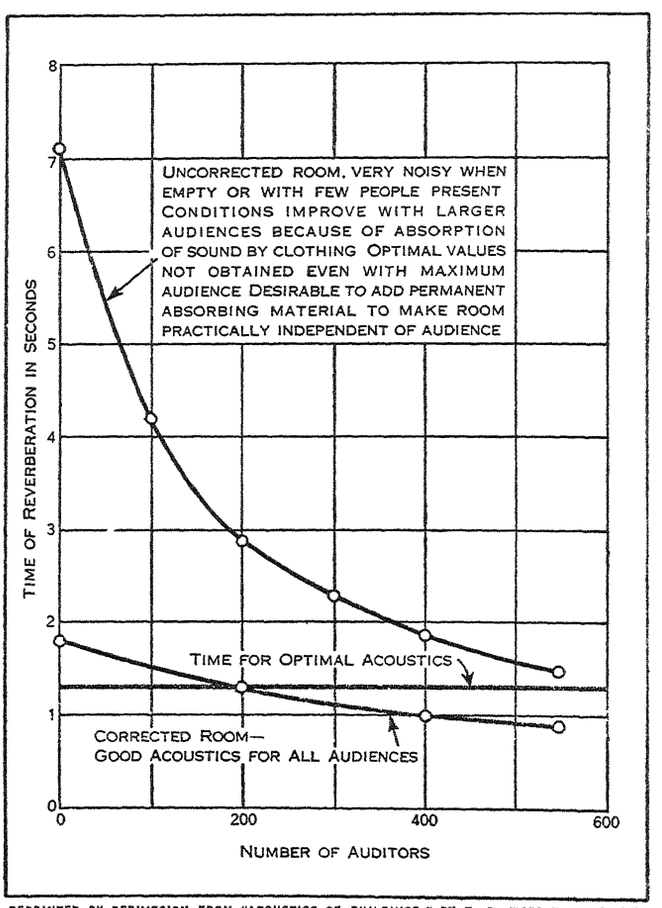

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FIG. 4.—REFLECTION OF SOUND WAVES ON CURVED AND CONVEX SURFACES




FROM H. F. OLSON, "ELEMENTS OF ACOUSTICAL ENGINEERING" (1942) COURTESY OF D. VAN NOSTRAND COMPANY, INC.

FIG. 3.—ARRANGEMENT OF THE COMPONENTS OF A SOUND-REINFORCING SYSTEM IN A THEATRE. THE GRAPH SHOWS THE INTENSITY LEVELS OF SOUND AT THE POSITIONS A, B, C, D, E AND F ON THE ORCHESTRA FLOOR. CURVE O GIVES THE INTENSITY LEVEL DUE TO THE UNAIDED SOURCE OF SOUND, WHILE CURVE L SHOWS THE REINFORCED INTENSITY FROM THE LOUD-SPEAKER, AND CURVE T REPRESENTS THE RESULTANT LEVEL OF THE TWO SOURCES. NOTE THAT THE RESULTANT LEVEL IS ALMOST UNIFORM OVER THE ENTIRE FLOOR

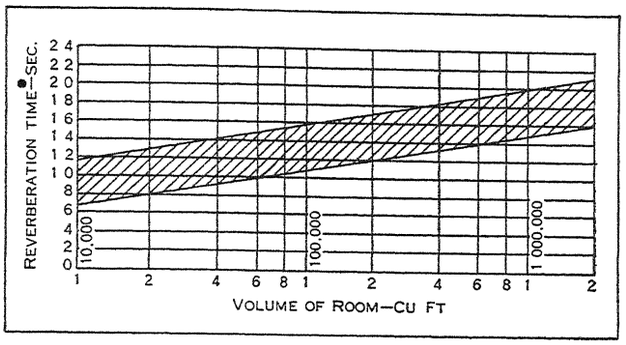



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FIG. 5.—EFFECT OF ACOUSTICAL TREATMENT ON REVERBERATION OF SOUND IN AN AUDITORIUM

**Echoes.**—An echo is a reflected sound that reaches the auditor about one-fifteenth of a second or more after the direct sound. If the reflecting surface is curved so as to converge the sound, the resulting echo is marked and annoying. Plane walls produce weak echoes, while convex walls diverge the reflected sound and are very beneficial in reducing echoes and in producing a more uniform distribution of sound in the room. Fig. 4 pictures the concentration of sound by a curved surface (left), and shows the beneficial scattering set up by convex panels in the wall (right). The amount of curvature suggested by Potwin in 1939 is a rise of 1 in. in each 10 in. along the wall surface. A rectangular-shaped room without curves is generally preferred, with convex segments and sound-absorbing panels in critical locations

**Reverberation,** or too great prolongation of sound, is the most usual acoustical defect in auditoriums. It is a common observation that the reverberations so noticeable in an empty house disappear when the house is furnished. So, in an auditorium, an adjustment is brought about by installing a sufficient amount of sound-absorbing material, selected to give the optimal time of reverberation, and by placing it where it will be most effective Fig 5 gives a graphical representation of the acoustical adjustment of an auditorium of 80,800 cu ft. volume, with an insufficient amount of 570 units of absorption before correction, and with 2,300 units after correction. The optimal time of reverberation selected for this auditorium was taken as 1.3 sec. when an audience of 200 was to be present. The shaded area in Fig. 6




COURTESY OF ACOUSTICAL MATERIALS ASSOCIATION

FIG 6 —TIMES OF REVERBERATION FOR AVERAGE SOUND FREQUENCY

indicates the times of reverberation for the average sound frequency of 512 cycles per sec that has been used by acoustical engineers in recent years (Acoustical Materials Association, *Bulletin VIII,* 1941.) For other frequencies than 512 cycles, somewhat different times have been used. (Maxfield and Potwin, *Jour. Acous. Soc. Amer.,* 11, p. 390, 1940.)

**Sound-Absorbing Materials.**—The absorption of sound in an auditorium is a vital consideration in securing good acoustics. Installing wires is a useless procedure Irregularities in the shape of the walls, columns, coffering and similar devices may break up the regular reflection and make the resultant sound more diffuse, but absorption must take place to reduce the reverberation. Since the usual building materials used in a room are plaster, wood and glass, all of which absorb only about 3% of the incident sound, it has become necessary to develop other materials with greater absorption. Some products absorb sound when they vibrate, particularly when backed by an air space, but most materials are effective because of their porosity, by which sound energy is transformed into heat by friction in the pores.

Sound-absorbing tests are made to determine the absorption coefficients that are needed when calculating the time of reverberation. A method was developed in 1895 by Wallace Sabine to measure the time of decay of pure tones in an empty reverberation room and again when an absorbing sample was placed on the floor. (*Collected Papers on Acoustics,* 1922.) Results obtained in different laboratories by this method were not in agreement. In 1939 a number of physicists discussed a new method in which the decay of sound in a room involves the normal acoustic impedance and the normal modes of vibration ("Symposium on the Measurement of Absorption Coefficients and the Application of Acoustic Absorbents," *Jour Acous. Soc. Amer.,* 11, pp. 37–106, 1939.) A wide choice of sound-absorbing materials is now (1943) available, as illustrated by the following sample information (Acoustical Materials Association, Chicago, Illinois, *Bulletin No. VIII,* 1941, which lists many materials):

| *Frequency* | *128* | *256* | *512* | *1024* | *2048* | *Average* |
|---|---|---|---|---|---|---|
| Coefficients | 0.12 | 0.15 | 0.47 | 0.95 | 0.78 | 0.60 |

The coefficients are determined for five frequencies, and an average is taken of four of them (256–2,048) to give the noise-reduction coefficient, which is used to express the relative sound-absorbing efficiency of the material. A coefficient of 1.00 indicates 100% absorption. In addition to the data shown in the tabulation, the *Bulletin* gives the following information:

"The material is in the form of cast units having a surface composed or resembling small uniform granules. The binder may be gypsum or any other suitable mineral binder; it is ¾ inches thick; weighs 2.37 lbs./sq.ft.; is cemented to plaster board; its surface is painted white having a light reflection value of 65 per cent" (Acoustical Materials Association).

**Acoustic Field Tests** in auditoriums are conducted to ascertain to what extent the acoustic conditions will give acceptable production and hearing of speech and music. The intelligibility of speech is tested when a speaker on the stage recites a list of specially selected words, while observers in different locations in the room write down what they think they hear. For satisfactory conditions, 80% or more of the words should be heard correctly. (N A. Watson and V. O. Knudsen, *Jour. Acous. Soc. Amer.,* 11, p. 406, 1940.) The time of reverberation is measured by a high-speed level recorder that gives the time rate of decay of the sound in decibels. A sound-level meter gives the loudness in different parts of the room to determine the uniformity of distribution of sound. The performance of the sound-amplifying system and the sound effects it produces in the auditorium are investigated by a trained radio engineer—not a simple test.

**Ideal Auditorium Acoustics.**—In 1928 Floyd R. Watson proposed a theory that good acoustics in auditoriums could be expected [illegible] two rules: (1) provide a stage with reflecting surfaces so that performers can "hear themselves", and (2) design the auditorium for listening so that the reflected sound will be reduced to be comparable with "dead" outdoor conditions, but with extraneous noise controlled. (Watson, *Acoustics of Buildings,* Chap. VII, 1941.) After 1928, various developments appeared to confirm the predictions of this theory. Burris-Meyer in 1941 modified a concert stage to give it the characteristics of a small, reverberant room, and received the enthusiastic approval of the performers. (*Jour. Acous. Soc. Amer.,* 13, p. 16.) Stahl and Louden (*Jour. Acous. Soc. Amer,* 13, p 9, 1941) found a "live end-dead end" room useful for testing absorption.

BIBLIOGRAPHY.—*Jour. Acoustical Society of America,* 1929–42; V. O. Knudsen, *Architectural Acoustics,* 1932; P. E. Sabine, *Acoustics and Architecture,* 1932; F. R. Watson, *Acoustics of Buildings,* 1941; National Bureau of Standards, *Report BMS-17* and *Supplement,* 1939–40; P. M. Morse, *Vibration and Sound,* 1936; also, references in the foregoing article. (*See* also SOUND.) (F. R. W)

**ACQUI,** city and episcopal see, province of Alessandria, Italy; from the town of that name it is 21 mi. S.S.W. by rail. Pop. (1936) 9,643 (town), 18,336 (commune). Its warm sulphur springs were already famous as Aquae Statiellae in Roman times. Part of the ancient bath establishment has been found; and south of the town are lofty arches of the aqueduct which supplied it. The place was connected by road with Alba Pompeia and Augusta Taurinorum. The town possesses a fine Gothic cathedral.

**ACRANIA,** or CEPHALOCHORDATA, a subphylum of the Chordata, including only *Amphioxus* (*q.v.*) and its allies.

**ACRE.** A harbour town or city of Palestine (Egypt. *'Ak (a),* Assyr. *Akku,* Heb. *Akko,* Gr. *Ake* [Josephus, *'Arke*], Lat. *Ac(c)e;* on Crusading coins *Ac(c)on,* Arab. *'Akka*). From the 3rd century B.C. it was known as Ptolemais, perpetuating, perhaps, the name of Ptolemy II (Philadelphus) The name St. Jean d'Acre dates from the time when it was the headquarters of the Knights Hospitallers.

**Topography.**—Acre is situated on a low, rocky promontory at the northern end of the Bay of Acre. A strong wall, shot pitted, girds it to seaward, and to landward a double rampart The ancient harbour has silted up leaving now only a few feet depth of water. In the roadstead there is good anchorage for small craft. To the south of the city, broadening as it advances, stretches the formerly marshy Plain of Acre. There enters the sea not far from the city the classic river Belus (Na'mān) which of old provided, and still provides the *murex* from which the Phoenicians extracted the renowned Tyrian purple

**History.**—Acre has had a most stirring and tragic history. Its strategic position on the military highway along the coast, its proximity to the western entrance to the Plain of Esdraelon, its significance as the natural port not only for Galilee, but for Damascus and the Hauran, coupled with the peculiar military value of its site, attached to it an enduring importance, both political and commercial. The name first appears in the conquest lists of the Egyptian monarchs Thutmose III (*c.* 1500 B.C.) and Seti I (*c.* 1315 B.C.). From the Amarna dispatches of Amenhotep IV (*c.* 1375 B.C.) it would appear that the caravans of Burra-Buriash II, king of Babylonia were plundered, much to his annoyance, by the king of Acre In the Old Testament it is named (Judges 1, 31) as one of the places whence the Israelites did not drive the Canaanite inhabitants. At the beginning of the 7th century B.C.

when the Assyrian was in the pride of his strength Acre appears to have been subordinate to Tyre for a time at least, since the two names are regularly coupled in inscriptions (Sinaherib, Asarhaddon). It is first mentioned apart in the records of Ashurbanipal (668–628). During the Persian period Acre is not much in evidence. It appears, however, to have been the rendezvous for Artaxerxes Mnemon in his expedition against Egypt (Strabo cvi. 2). From this time on "for Egypt, for Asia Minor, for the Greek isles and mainland, and for Italy its harbour was the most convenient on the Syrian coast, and its history till the end of the New Testament period is that of the arrival of great men from these shores, of the muster of large armies, of the winter camps of the invaders of the Syrian hinterland, and of bitter conflicts between Greeks and Jews" (G. A. Smith). Josephus and the Books of the Maccabees record its varying fortunes. Within its walls the Syrian Greeks, routed by Simon Maccabaeus, sought refuge (164 B.C.). In the struggle for the Syrian throne, Alexander Balas wrested Acre from Demetrius (153). Jonathan was lured within its gate (Acre has only one) by Trypho and taken prisoner (143). Round about the year 104 B.C. Alexander Jannaeus laid siege to Acre but abandoned it from fear of Ptolemy Lathyrus, who besieged and took it, but was forced to yield it to his mother Cleopatra. Tigranes of Armenia stormed it (70 B.C.) but relinquished it under fear of the Romans and it surrendered without a struggle to the Parthian Pacorus (Josephus, *B.J.* i. 13). Herod entertained Caesar here and here he built a gymnasium. It was established a *colonia* by Claudius. St. Paul spent a day in Ptolemais while coasting from Tyre to Caesarea (Acts xxi. 7). In the wars with the Jews the Roman leaders realized its value as main base for their armies (Varus, Vitellius, Petronius, Cestius, Vespasian).

In Christian times Ptolemais became a bishopric and its bishop attended the great councils of the Church, Caesarea (198), Nicea (325), Constantinople (381), Chalcedon (451), Jerusalem (536). The Arabs took possession of the city in 638. Baldwin I. captured it with the aid of a Genoese fleet in 1104 (1st crusade). Saladin re-captured it in 1187 (2nd crusade). In 1191 after a siege by Guy de Lusignan of about two years, it was taken on the arrival of Richard Coeur de Lion (3rd crusade), and was finally lost in 1291. The Turks under Selim I entered into possession in 1517, after which the city fell into decay. Its revival began in 1749 with its capture by Omar ez-Zahir, and it emerged into prominence, prosperity and virtual independence under his successor "Ahmad el-Jazzar" ("the butcher"). Supported by a British fleet under Sir Sidney Smith it resisted Napoleon successfully in 1799. The year 1832 saw its capture and wreck by Ibrahim Pasha of Egypt. On Nov. 4, 1840, the city was attacked by the allied fleets (British, Austrian, Turkish) under Sir Charles Napier and after three hours' bombardment reduced. Restored in the following year to Turkey it remained in Turkish hands till Sept. 23, 1918, when it was occupied by the 13th Cavalry brigade (5th Cavalry division) of the Egyptian Expeditionary force with little or no opposition.

**Modern.**—Acre with a population (est. 1940) of 9,500 (8,000 Muslims) is in British mandated territory and under the administrative partition of Palestine in the northern province (Phoenicia and Galilee). Under Turkish rule it was the chief town of a governmental district. Formerly the chief port of shipment for grain brought on camel-back from the Hauran, its trade was much diminished with the opening of the Damascus-Beirut railway in 1896 and practically extinguished when the Haifa-Damascus railway in 1906 diverted what remained to Haifa. It has now a small coasting trade in locally grown grain, sesame seed and oil and a small export of oranges to Beirut. Brass and copper ware are made to a small extent. It is now a customs sub-station to Haifa. Acre is the chief seat of Baha'i religion, an offshoot of Babism, with an estimated number of adherents at 2,000,000. The founder 'Abdu-l Baha died here in 1921 and was succeeded by his grandson Shauki Effendi, who was made life-president of the council of nine, which regulates the affairs of the community. Few buildings of interest have survived the buffetings to which the city has been repeatedly subjected. The most notable, perhaps, is the large mosque built by el-Jazzar. Four commodious khans recall the times when 2,000 to 3,000 camels, grain laden, would arrive in a day. British administration has been responsible for the establishment of a government hospital, a forest nursery, and a large convict prison. A railway from Beirut along the coast to Acre was built in 1942.

BIBLIOGRAPHY.—Reland's *Palestina* (1714); E. Robinson, *Later Biblical Researches in Palestine* (1852); G. A. Smith, "Ptolemais" (*Encyc. Biblica.* 1902); Luke and Keith Roach, *The Handbook of Palestine* (1922). (E. Ro.)

**Battle of Acre.**—The battle of 1189, fought on the ground to the east of Acre, affords a good example of battles of the Crusades. Saladin's victory at Tiberias in 1187 had led to the fall of Jerusalem and to that of almost all the Christian strongholds in Palestine and Syria, save Tyre, Antioch, and Tripoli. The attempt to regain Acre led to the battle described below and was in turn a prelude to the Third Crusade under Richard I. of England and Philip of France. The crusading army under Guy de Lusignan, king of Jerusalem, which was besieging Acre, gave battle on Oct. 4, 1189, to the relieving army raised by Saladin. The Saracens lay in a semicircle east of the town, facing inwards towards Acre. The Christians opposed them with crossbowmen in first line and the heavy cavalry in second. At Arsuf (*q.v.*) the Christians fought coherently; here the battle began with a disjointed combat between the Templars and Saladin's right wing. The crusaders were so far successful that the enemy had to send up reinforcements from other parts of the field. Thus the steady advance of the Christian centre against Saladin's own corps, in which the crossbows prepared the way for the charge of the men-at-arms, met with no great resistance. But the victors scattered to plunder. Saladin rallied his men and, when the Christians began to retire with their booty, let loose his light horse upon them. No connected resistance was offered, and the Turks slaughtered the fugitives until checked by the fresh troops of the Christian right wing. Into this fight Guy's reserve, charged with holding back the Saracens in Acre, was also drawn, and, thus freed, 5,000 men sallied out from the town to the northward; uniting with the Saracen right wing, they fell upon the Templars, who suffered severely in their retreat. In the end the crusaders repulsed the relieving army, but only at the cost of 7,000 men.

*See* Oman., *Hist. of the Art of War in the Middle Ages*, vol. 1. 333–340 (1924).

**ACRÉ** or **AQUIRY**, a river of Brazil and principal tributary of the Purús, rising on the Bolivian frontier and flowing easterly and northerly to a junction with the Purús at 8° 45′ S. The name is also applied to a district situated on the same river and on the former (1867) boundary line between Bolivia and Brazil. The region, which abounds in valuable rubber forests, was settled by Bolivians between 1870 and 1878, but was invaded by Brazilian rubber collectors during the next decade and became tributary to the rubber markets of Manáos and Pará. In 1899 the Bolivian Government established a customhouse at Puerto Alonso, on the Acré river, for the collection of export duties on rubber, which precipitated a conflict with the Brazilian settlers and finally brought about a boundary dispute between the two republics. In July 1899, the Acréanos declared their independence and set up a republic of their own, but in the following March they were reduced to submission by Brazil. Various disorders followed until Brazil decided to occupy Puerto Alonso with a military force. The boundary dispute was finally settled at Petropolis on Nov. 13, 1903, through the purchase by Brazil of the rubber-producing territory south to about the 11th parallel, estimated at more than 60,000 sq.m.

**ACRE**, a land measure used by English-speaking races. Derived from the O.E. *acer* and cognate with the Lat. *ager*, Gr. *ἀγρός*, Sans. *ajras*, it has retained its original meaning "open country," in such phrases as "God's acre," a churchyard, or "broad acres," etc. As a measure of land, it was first defined as the amount a yoke of oxen could plow in a day; statutory values were enacted in England by acts of Edward I. and III., Henry VIII., George IV.; the Weights and Measures Act 1878 defines it as 4,840sq.yds. This is the American acre. In addition to this

statute, or imperial, acre, other acres are still, though rarely, used in Scotland, Ireland, Wales and certain English counties. The Scottish acre contains 6,150 4 sq.yd.; the Irish acre 7,840 sq.yd.; in Wales, the land measures *erw* (4,320 sq.yd.), *stang* (3,240 sq yd ) and *paladr* are called acres.

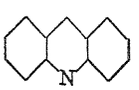
The Leicestershire acre (2,308¾ sq.yd ), Westmorland acre (6,760 sq yd ) and Cheshire acre (10,240 sq yd.) are examples of local values

**ACRIDINE** is a solid, crystallizing in needles of melting point 110° C., found in coal-tar anthracene. It is characterized by its irritating action on the skin, and by the blue fluorescence shown by solutions of its salts.

Acridine is extracted from the crude anthracene by dilute sulphuric acid, the sulphuric acid solution is treated with potassium dichromate, and the precipitate of sparingly soluble acridine dichromate is decomposed with ammonia (C. Graebe and H. Caro, *Ann.* [1871]).

Acridine and its homologues are stable compounds of feebly basic character, belonging to the general class of heterocyclic ring compounds (*see* CHEMISTRY: *Organic Chemistry*). They combine readily with the alkyl iodides to form alkylacridinium iodides, which are readily transformed by the action of alkaline potassium ferricyanide to N-alkylacridones.

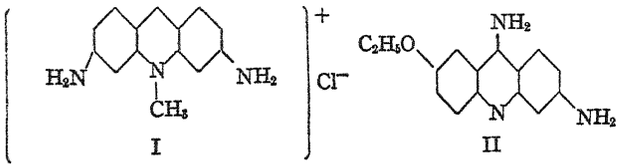
Acridine itself has the structural formula



It owes its basic properties to the presence of the tertiary nitrogen atom; it may be regarded as consisting of two benzene nuclei fused to a pyridine nucleus, and shows characteristics both of the former (homocyclic) and the latter (heterocyclic) structure

Phenylacridine is the parent base of chrysaniline, the chief constituent of the dyestuff phosphine (a by-product in the manufacture of rosaniline). The dyestuff phosphine must be distinguished from the phosphorus hydride of the same name, and from the organic derivatives of this substance, to which the general term phosphine is also given. Chrysaniline (diamino-phenylacridine) forms red salts, dyeing silk and wool a fine yellow; the solutions of the salts are characterized by their fine yellowish-green fluorescence.

Several acridine derivatives and notably acriflavine (*syn.* trypaflavine, euflavine) found extensive use during World War I as antiseptics for infected wounds (C. H. Browning and others). The preparation of acriflavine (I) and of proflavine, another acridine antiseptic of similar type was described by L. Benda (1912).



I II

Rivanol (II) also of the acridine series was recommended by J. Morgenroth (1921) as a powerful tissue antiseptic against spreading infection caused by streptococcus.

The antimalarial quinacrine (atabrine) is an acridine derivative.

**ACRIFLAVINE,** an acridine derivative obtained from coal tar, is a reddish-brown powder with antiseptic properties. Introduced as an antiseptic in 1912 by Paul Ehrlich as trypaflavine, it was used extensively in World War I but later was largely replaced by such chemotherapeutic agents as the sulfonamides and antibiotics.

In solutions it is used as the hydrochloride or as the less irritating base, neutral acriflavine, for irrigating wounds and for the treatment of gonorrhoea. As a urinary antiseptic, it may be taken by mouth. (F. L. A.)

**ACRO, or ACRON, HELENIUS,** Roman grammarian, probably flourished at the end of the 2nd century A.D. He wrote commentaries on Terence and perhaps Persius. A collection of scholia on Horace was wrongly attributed to him.

*See* O. Keller (ed.), *Pseudoacronis Scholia in Horatium Vetustiora.*

**ACROLITHS,** statues of a transition period in the history of plastic art, in which the trunk of the figure was of wood, and the head, hands and feet of marble. The wood was concealed either by gilding or, more commonly, by drapery, and the marble parts alone were exposed.

**ACROMEGALY,** a condition characterized by an enlargement of both bony and soft parts of the hands, feet and face. It occurs in adults and is due to an oversecretion of the growth hormone of the anterior lobe of the pituitary gland.

A similar overactivity in childhood and early adolescence gives rise to giantism. (*See* ENDOCRINOLOGY.) (F. L. A.)

**ACRON,** a Greek physician of the 5th century B.C., born at Agrigentum in Sicily, was contemporary with Empedocles. The method of lighting large fires and purifying the air with perfumes, to put a stop to the plague in Athens (430 B.C.), is said to have originated with him.

**ACROPOLIS,** literally the upper part of a town (Gr. ἄκρος "top," πόλις, "city").

For purposes of defense early settlers chose elevated ground, frequently a hill with precipitous sides, and these early citadels became in many parts of the world the nuclei of large cities which grew up on the surrounding lower ground. The word acropolis, though associated primarily with Greek towns (Athens, Argos, Thebes, Corinth), is applied to all such citadels. The most famous is that of Athens, which, by reason of its historical associations and the famous buildings erected upon it, is generally known as *the* Acropolis (*see* ATHENS).

**ACROPOLITA (AKROPOLITES), GEORGE** (1217–1282), Byzantine historian and statesman, was born at Constantinople. At an early age he was sent to the court of John Ducas Batatzes (Vatatzes), emperor of Nicaea, by whom and by his successors (Theodorus II Lascaris and Michael VIII Palaeologus) he was entrusted with important state missions. The office of "great logothete," or chancellor, was bestowed upon him in 1244.

Acropolita's most important political task was that of effecting a reconciliation between the Greek and Latin Churches. In 1273 he was sent to Pope Gregory X, and at the Council of Lyons (1274) in the emperor's name he recognized the spiritual supremacy of Rome.

In 1282 he was sent on an embassy to John II, emperor of Trebizond, and died in the same year.

His historical work (Χρονικὴ Συγγραφή, *Annales*) embraces the period from the capture of Constantinople by the Latins (1204) to its recovery by Michael Palaeologus (1261), thus forming a continuation of the work of Nicetas Acominatus. It is valuable as written by a contemporary, whose official position gave him access to trustworthy information.

He wrote several shorter works, among them being a funeral oration on John Batatzes, an epitaph on his wife Eirene and a panegyric of Theodorus II Lascaris of Nicaea. While a prisoner at Epirus, he wrote two treatises on the procession of the Holy Ghost.

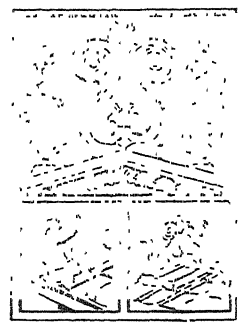
BIBLIOGRAPHY.—Editio princeps of the *Annales* by Leo Allatius (1651), with the editor's famous treatise *De Georgiis eorumque Scriptis;* editions in the Bonn *Corpus Scriptorum Hist. Byz.*, by I. Bekker (1836), and Migne, *Patrologia Graeca,* cxl; in the Teubner series by A. Heisenberg (1903), vol. ii of which contains a full life, with bibliography; *see* also C. Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

**ACROSTIC,** a short verse composition, so constructed that the initial letters of the lines, taken consecutively, form words (Gr. ἄκρος, "at the end," and στίχος, "line" or "verse"). The fancy for writing acrostics is of great antiquity, having been common among the Greeks of the Alexandrine period, as well as with the Latin writers since Ennius and Plautus, many of the arguments of whose plays were written with acrostics on their respective titles. One of the most remarkable acrostics was contained in the verses cited by Lactantius and Eusebius in the 4th century, and attributed to the Erythraean sibyl, the initial letters of which form the words Ἰησοῦς Χριστὸς Θεοῦ υἱὸς σωτῆρ, "Jesus Christ, the son of

God, the Saviour." The initials of the shorter form of this again make up the word Ἰχθύς (fish), to which a mystical meaning has been attached (Augustine, *De Civitate Dei,* 18, 23), thus constituting another kind of acrostic.

Acrostic verses have always been held in slight estimation from a literary standpoint. Dr. Samuel Butler says, in his "Character of a Small Poet," "He uses to lay the outside of his verses even, like a bricklayer, by a line of rhyme and acrostic, and fill the middle with rubbish." Addison (*Spectator,* No 60) found it impossible to decide whether the inventor of the anagram or the acrostic were the greater blockhead; and, in describing the latter, says, "I have seen some of them where the verses have not only been edged by a name at each extremity, but have the same name running down like a seam through the middle of the poem." And Dryden, in *Mac Flecknoe,* scornfully assigned Shadwell the rule of

Some peaceful province in acrostic land.



FROM BUHLMANN, "CLASSIC AND RENAISSANCE ARCHITECTURE," NEFF AND HELBURN

TWO GREEK ACROTERIA Top and lower right, front and back of apex type. (From Fletcher, "Hist. of Arch.," Batsford.) Lower left, eaves type

The name acrostic is also applied to alphabetical or "abecedarian" verses. Of these we have instances in the Hebrew psalms (*e.g.,* Ps. xxv and xxxiv), where successive verses begin with the letters of the alphabet in their order. The structure of Ps. cxix. is still more elaborate, each of the verses of each of the 22 parts commencing with the letter which stands at the head of the part in our English translation.

At one period much religious verse was written in a form imitative of this alphabetical method, possibly as an aid to the memory. The term acrostic is also applied to the formation of words, from the initial letters of other words. Ἰχθύς, referred to above, is an illustration of this. So also is the word "Cabal," which, though it was in use before, with a similar meaning, has, from the time of Charles II., been associated with a particular ministry, from the accident of its being composed of Clifford, Ashley, Buckingham, Arlington, and Lauderdale.

*Double acrostics* are such as are so constructed, that not only initial letters of the lines, but also the middle or last letters, form words. For example:—1. By Apollo was my first made. 2. A shoemaker's tool. 3. An Italian patriot. 4. A tropical fruit. The initials and finals, read downwards, give the name of a writer and his *nom de plume.* Answer *Lamb, Elia*

1. L yr E
2. A w L
3. M azzin I
4. B anan A

A curious and clever 20th-century development of the acrostic is the quadruple acrostic. The following, taken from R. A. Knox's *Book of Acrostics,* is a good example.

Uprights: Since there's no A, B, let us C and D.

Lights: 1. Reverse the name a schoolboy might apply, for briefness, to his weekly subsidy.
2. A lady thus (but with an S)
   In Southern lands you might address.
3. Initials seen on many a truck.
4. To cattle breeders brings bad luck.

SOLUTION

Uprights: "Since there's no help, come, let us kiss and part."
Lights: 1. HsaCteKcoP (Reverse of Pocket Cash).
2. (s) En Or It A
3. L M.S R.
4. P E S T

Acrostics may be very simple and also very intricate. The modern acrostic seems to hit the happy medium and, whilst giving the reader plenty of food for thought, sends him occasionally to his Cruden, his classical dictionary or his encyclopaedia

BIBLIOGRAPHY.—P. M. Pearson, *Acrostic Dictionary* (1901); R. A. Knox, *Book of Acrostics* (1924); L. C. Scott, *Acrostic Poems* (Iowa, 1924).

**ACROTERIUM** or AKROTERION, in architecture, a statue or ornament of any kind placed on the apex or at the lower angles of a pediment. The word is sometimes restricted to the pedestal supporting such an ornament.

**ACT,** a word varying in significance according to the sense in which it is employed. It is often synonymous with "statute" (*see* ACT OF PARLIAMENT). It may also refer to the result of the vote or deliberation of any legislature, the decision of a court of justice or magistrate, in which sense records, decrees, sentences, reports, certificates, etc., are called *acts.* In law act means any instrument in writing, which declares or proves the truth of a bargain or transaction, as: "I deliver this as my act and deed" The origin of the legal use of the word "act" is in the *acta* of the Roman magistrates or people, of their courts of law, or of the senate, meaning (1) what was done before the magistrates, the people or the senate; (2) the records of such public proceedings. In the sense of "document" it is used in those systems of law which are derived from the Roman.

**ACTA DIURNA,** called also *Acta Populi, Acta Publica* and simply *Acta* or *Diurna,* in imperial Rome a sort of daily gazette, containing an official narrative of noteworthy events at Rome. Its contents were partly official (court news, decrees, etc), partly private (notices of births, etc.). Thus to some extent it filled the place of the modern newspaper (*q.v.*). The *Acta* were originated by Julius Caesar, who ordered the keeping and publishing of the acts of the people by public officers. The *Acta* were exposed daily in a public place on a whitened board (*see* ALBUM). After remaining there for a reasonable time they were taken down and preserved with other public documents, so that they might be available for reference.



AFTER A CAST IN METROPOLITAN MUSEUM OF ART

ACTAEON, MYTHICAL HERO AND HUNTER, KILLED BY HIS HOUNDS FOR HAVING ACCIDENTALLY SEEN DIANA (ARTEMIS) WHILE BATHING

The *Acta* differed from the Annals (discontinued in 133 B.C.) in that only the more important matters were given in the latter, while in the former things of less note were recorded. Their publication continued till the transference of the seat of the empire to Constantinople.

*See* Gaston Boissier, *Tacitus and other Roman Studies* (Eng. trans. W. G. Hutchison, 1906), p. 197–229.

**ACTAEON,** son of Aristaeus and Autonoë, Boeotian hero and hunter. According to Ovid (*Metam.,* iii. 131), having accidentally seen Artemis on Mt. Cithaeron while she was bathing, he was changed by her into a stag, and pursued and killed by his 50 hounds. His statue was often set up on rocks and mountains as a protection against excessive heat, and the myth itself probably represents the destruction of vegetation during the 50 dog-days. Aeschylus and other tragic poets and artists made use of the story, which is illustrated by a noted small marble group in the British Museum.

**ACTA SANCTORUM,** a collection of the lives of the saints, arranged day by day according to the calendar, and compiled by the Bollandists, Belgian Jesuits. The work, first conceived at the commencement of the 17th century, has been carried on ever since, save during the period of the suppression of the Society of Jesus in Belgium. In 1925 the fourth volume for November, dealing with the days Nov. 9 and Nov. 10, was published. (*See* BOLLANDISTS)

**ACTA SENATUS** or **COMMENTARII SENATUS,** minutes of the discussions of the Roman senate. Before the first consulship of Julius Caesar (59 B.C.), minutes of the proceedings of the senate were occasionally published, unofficially; Caesar, however, ordered them to be issued authoritatively. The keeping

of them was continued by Augustus, but their publication was forbidden A young senator was chosen to draw up these Acta, which were kept in the imperial archives and public libraries Special permission from the city praefect was necessary in order to examine them. (*See* ACTA DIURNA.)

**ACTING.** Greek drama is usually given first consideration in connection with the origin of dramatic art, but the basic reasons for imitation, mimicry and what is now called "acting" are found in the study of the lower races of man. Make-believe, or the desire to imitate, is, perhaps, most common among children the world over, and it appears also among many animals.

Loomis Havemeyer points out (*The Drama of Savage Peoples*) that "there is a twofold purpose in this imitation characteristic of savage peoples. The first and simplest is that it gives a pleasurable sensation similar to the real experience. And, secondly, it enables man to convey his impressions to others—*i.e*, it is a form of language" From the last purpose grew the gesture, or any bodily gesticulation or facial expression that serves as an aid to, or a substitute for, the spoken language of the savage. It was a common means of communication.

**Development.**—The evolution of acting, from its simple beginnings to modern times, is summed up by Brander Matthews (*The Development of the Drama*) "The dramaturgic faculty is evolved slowly with the growth of civilization; and play-making skill is one of the latest of human accomplishments. But the rudimentary is everywhere visible, even among the most primitive peoples. As we consider the history of human progress, we perceive that the drama is almost the very earliest of the arts, as early, perhaps, as the art of personal adornment; and we discover also that it is the very latest to attain its complete expression. But in the noblest work of the Greek dramatists, and in the most powerful plays of the Elizabethans, the same principles are applied which we discover, doubtlessly, in the rudest theatrical attempts of the lowest savages. It is out of the crude efforts, such as still may be observed among the Eskimo and the tribes of the Amazon, that the dramatic art was toilfully developed by our own predecessors as taste refined and civilization advanced. The traditions of these rude play-makers were passed down from generation to generation, and the art slowly discovered itself."

**Grecian Influences.**—It was not until the gods of Egypt were accepted by the Greeks that there appears any ceremony which can be truly called dramatic. The Greek drama arose through the worship of the gods of vegetation, and later developed into the form of the plays of the great dramatists. It is difficult, however, to think of the drama of the Greeks without thinking of its close connection with the dance. The myth was the subject matter; the dance was the expression of that subject matter, be it the idea of spring, the awakening of new life, or the representation of various objects such as trees and events by means of gestures, postures and attitudes. In the early religious history of Greece all the people took a part in the dramatic dances around the altar, but later, a certain few of the most capable actors were selected from the chorus to play outstanding *rôles,* or to play many, and sometimes all, of the parts in the play—inasmuch as the custom of wearing masks made this possible. The number of principal actors in a Greek play seldom exceeded three, and it was more common to have only one character appear at a time. Thus it was that acting became a profession, and, among the Greeks, a very noble one. The profession was confined entirely to men.

**Italian Interests.**—In Italy the dramatic instinct has been very pronounced among its people as far back as records show. The dramatic literature of Italy has emerged from centuries of political and religious strife, but through all these troubled days the genius of the Italian people has led it to love the drama, and more—the art of acting. Before the writing of plays, and even after, as in the *Commedia dell'arte,* it has not been uncommon for a group of people to dramatize impromptu. Given a theme on which to bring out some feeling or desire, they express this spontaneously in the form of a play. The love of music, dance and spectacle did more, perhaps, to preserve this interest in the dramatic art through the political and religious struggles—the periods that provided no dramatic literature—than any other influence.

**The Elizabethan Drama.**—The art of acting was emphasized more by Shakespeare than by any other dramatist of his day His plays show a remarkable interest in characterization, in which he brought forth every known type of humanity that would fit into the tragic or comic *rôles* that he created. It should be noted that between 1810 and 1835, a period described by William Archer as "the winter solstice of English drama," English acting reached its highest peak in the genius of Edmund Kean. For his greatness we have the testimony of the masterly criticism of William Hazlitt and Leigh Hunt. Yet it is doubtful that, without the strong emphasis on Shakespearean production at the time, Kean or his fellows would have so flourished. Shakespeare's own convictions as to the importance of acting, shown in Hamlet's speech to his players, cannot be overestimated, for here he incorporates the fundamentals of good acting, the important factors in the better use of the voice and body:

"Speak the speech, I pray you, as I pronounced it to you, trippingly on the tongue; but if you mouth it, as many of your players do, I had as lief the town-crier spoke my lines. Nor do not saw the air too much with your hands, thus; but use all gently; for in the very torrent, tempest, and, as I may say, whirlwind of your passion, you must acquire and beget a temperance that may give it smoothness. Oh, it offends me to the soul to hear a robustious, periwig-pated fellow tear a passion to tatters to very rags, to split the ears of the groundlings who, for the most part, are capable of nothing but inexplicable dumb-show and noise; I would have such a fellow whipped for o'erdoing Termagant; it out-Herods Herod, pray you, avoid it."

"Be not too tame, neither, but let your own discretion be your tutor; suit the action to the word, the word to the action . . ."

**Views of Diderot.**—It was not until about the 18th century that the different theories, or definite systems, of acting began to appear to any extent. Denis Diderot, the French encyclopaedist, grew weary of the classical French drama, with its conventional acting, and advanced as its opposite the theory of a drama of real life, which was, among other things, to be a truer reflection of the bourgeois of France. Diderot said (*Paradoxe sur le comédien*) that "The possibilities of a good actor lie in the complete absence of sensibility," and recommended to the actor that he should watch himself during the performance, that he should listen to his voice and give only "recollections of his emotions."

Theodore Komisarjevsky, formerly producer and art director of the Moscow State and Imperial theatre, wrote of this theory: "It is proved now that an actor cannot move the audience, or be in any way creative on the stage, if he watches himself acting. Instead of being concentrated on the images he has to create, on his inner self, he becomes concentrated on his outer self, becomes self-conscious and loses the power of imagination. The better way is to act only with the help of the imagination; to create, and not to imitate or reproduce one's own life experiences. When the actor playing a part is living in a world of images created by his own phantasy, he cannot and need not watch and control himself. The images created by the actor's phantasy, and obedient to his call, control, guide and direct his emotions and actions during the performance."

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(F. L. D.; R. MY)

## MODERN TENDENCIES

The 20th century has seen several new and distinct theories of acting. Different schools, academies of acting and theatres, mostly repertory, have done a great deal towards improving the standard of acting and team work or ensemble acting, on the stage: notably, in England, the Repertory theatre in Birmingham and the Liverpool Repertory theatre; in Ireland the Abbey theatre, Dublin. Such English producers as Gordon Craig, Granville Barker, Basil Dean, J. B. Fagan, Lewis Casson, Nigel Playfair, performed very important work in improving the quality of acting, and creating stage ensembles, not only directly by their stage work, but also by their writings on the subject. In the United States, David Belasco, the Theatre Guild of New York,

the Washington Square Players, the Provincetown Playhouse and such producers as Arthur Hopkins, R. E Jones, the Reichzts and others contributed to this improvement Moreover, the Little Theatre movement (*q.v.*) in the U S must not be overlooked.

Producers such as Max Reinhardt in Germany and Firmin Gémier in Paris used, for the most part, the methods of acting created by the naturalists, André Antoine in France, and Kroneg, the producer of the German Meininger company, and developed by Otto Brahm in Berlin and by Stanislavsky in Moscow Sometimes these producers introduced, in this naturalistic acting, ideas of the formalists, Georg Fuchs in Germany, Vsevolod Meyerhold and Alexander Tairof in Russia, Gordon Craig in England and others. Sometimes they introduced touches of the synthetic theories of acting advocated by Komisarjevsky after 1910. The majority of the French actors trained in the Conservatoire in Paris remained still under the influence, not only of the old romantic school, but also of the pseudo-classical school of acting of the 18th century.

**Naturalism.**—The best-known of all the new theories of acting which appeared after 1910 was the system of Stanislavsky, the leading producer and director of the Moscow Art theatre. His system was founded on the principle that an actor, having to be natural and sincere on the stage, could be so only by means of reproducing emotions experienced at some time or other in his life. That form of "psychical naturalism" became part of Stanislavsky's system as a result of "outer naturalism," which he advocated before he turned to psychology in the endeavour to find out a scientific system of acting.

The "inner naturalism" in acting was not a new feature in Stanislavsky's theory. Some French theatrical theorists had already, in the 18th century, founded their systems of acting on the same ideas. They held that an actor can represent himself on the stage only if it is desired that he should be sincere; that "love scenes are much better played by actors who are in love in real life." Like the followers of Jean Racine, Stanislavsky believed that contemporary actors living in their own time, and each one in his special atmosphere, are unable to produce other emotions than those that are applicable to the time and to the surroundings in which they lead their every-day life. To be sincere, they must place, beneath the lines and stage directions of the author, their own emotions already experienced in real life.

It is quite clear that this type of acting destroys the form created by the author of the play and the rhythm of his lines, which express the inner content and the inner movements of the play. The actor who acts by the power of his imagination passes from the form and the rhythm of the play to the inner content of it. The idealistic and emotional content of the play, which he obtains through the form and rhythm of the play, exists in his imagination, and produces the necessary working of his intellect to create a stage character with all its peculiarities. The pupil of Stanislavsky neglects the form and rhythm of the play and substitutes his own remembered, intellectual states in place of those of the author.

**The Formalists.**—Another system, opposed to Stanislavsky's ideas, was advocated by the symbolists, the formalists and the expressionists. Here we have a complete negation of sincerity and life-likeness; the less the acting is sincere and life-like the better. The actor must not try to create any definite characters; he must represent abstract ideas, and convey these through his speeches delivered in a formal way, and through his movements and gestures, again produced in a formal, unlife-like and "picturesque" or marionette-like style. The Russian and German formalists, Meyerhold, Tairof and Erwin Piscator, after the Revolution, became much interested in acrobatics and circus business; the movements of the actors in their productions became something akin to a *perpetuum mobile,* dominating both the psychology of the play and the meaning of the lines. Thus the acting on their stages resembled a mixture of circus and cubistic ballet performance. Later, Meyerhold returned to the more or less naturalistic style. Some impressionists, such as Leopold Jessner and Nicholas Evreinov, used formal methods interspersed with psychological touches. Actors on the French *avant-garde* stages worked on somewhat similar lines at the Atelier directed by Charles Dullin, in the productions of Georges Pitoef and Louis Jouvet. At the *Vieux Colombier,* they used the same methods of acting Jacques Copeau, the director of that theatre, must be considered as a pioneer, in France, in the fight against naturalism and the old-fashioned Conservatoire acting. He definitely introduced such new methods of acting as the psychological and the formal on the French stage

## ACTING IN THE ENGLISH-SPEAKING COMMERCIAL THEATRE

The English-speaking theatre after 1920 accelerated its divergence from the Russian and European theatres, and acting reflected that divergence. The public bestowed its patronage upon the new and the original The repertory system and the so-called "stock" system of revivals diminished almost to the vanishing point, although a reappearance of these systems is now happily to be seen. The theory of continuity and tradition which flourished in Europe prior to World War I relinquished any hold it had on the commercial theatre of the United States and England. Only in the case of the Shakespearean classics did the repertory idea survive, as for instance in the "Old Vic" and Stratford on-Avon companies in England; and even there the emphasis was continually placed on fresh interpretation. The U S. never had "schools" of acting within the European meaning of a company of actors drilled and trained by a director or producer who taught a "style." From Henry Irving, Edwin Booth and Richard Mansfield, through Gerald du Maurier, John Drew and the Barrymores, no claim, or even effort, was made to establish any method of acting. Ellen Terry and Ada Rehan, Maude Adams and Mrs. Patrick Campbell not only set no rigid principles for their craft, but lavished their scorn upon copyists.

The theatre today (1945) cannot even point to "typical" acting, so great has been the emphasis upon the fresh, the new, the unexpected. A "star" may be born between 8.30 and 11.00 P M of an opening night, although he may never have faced an audience before that night, so great is the public's appetite for the original. And yet that star may fade abruptly without another flicker if he cannot adapt his talents to the next play. The public is loyal to the actor, but it is noticeable that it is increasingly impatient of fads and easily tired of idiosyncrasies. It is no longer sufficient for the actor with personality and certain hallmarks of mannerism to exhibit himself, with a play as a background. The stylized actor—the actor who has too close an adherence to any manner of acting—finds that he fails to convey illusion to the audience precisely because he produces the expected. The actor who acts for a living on the English-speaking stage today does so in a theatre run by private enterprise for profit to all concerned. He must adapt his talents to the practical considerations of that theatre or he will not get a chance to do any acting. He must transmit across the footlights a clear-cut presentation of the playwright's concept and he must maintain the illusion of spontaneity for the run of the play.

Today's commercial theatre is based on the "long run." Producers, meeting the competition of the motion picture and radio, bring to each play the best obtainable elements in presentation. This is expensive, and so perforce they run the play for as long as there is patronage for it, with no regard whatsoever to the effect upon the future career of an actor. The actor, in the average successful play, must give from 200 to as many as 1,000 or more performances without interruption. He must give as valid an illusion of spontaneity at any one of these performances as on the opening night. In addition, if he desires future theatrical employment, he must also manage to maintain sufficient versatility to make him eligible for an entirely different new play. Nobody will take care of this for him but himself. How he does this in the present-day theatre, is strictly up to him. There is no formula of acting which is likely to hold good for any two plays, or for any two actors.

The actor must find his own training, because producers and directors make no effort to train him beyond a given play for which his services may be desired. Any precise method he may choose to study is his own choice and so presumably congenial

to his natural tendencies of expression In seeking employment he is under no handicap of prejudice against any particular method of training he may have selected, nor is he necessarily handicapped if he has provided himself with no training.

The director of a production is, of course, indispensable; but he has no obligation to teach an actor how to develop a characterization, nor how to sustain a performance once it is worked out In the ordinary circumstance the director's work with the actor is limited to the rehearsal and try-out period of a particular play, and his efforts with regard to the acting under his control are concerned entirely with that play. The opportunities for young actors to work under a good director in a number of varied plays, before playing on the commercial stage, are unfortunately very limited in the English-speaking theatre.

This practical circumstance of the "long run" has forced the actor to abandon any reliance on the theories of those who, like Meyerhold, Stanislavsky, Gordon Craig and others, attempted to find a scientific basis for acting. He must act the same part under any and all circumstances, personal and extraneous to him. However much he may yearn for the luxury of "use your own emotions in your acting," it is obviously physically impossible for him to do so for several hundred consecutive times. He has been forced to acquire a technical concept of his performance—a control—which will not desert him in order to assure the play consistency, and lest he blur or distort the playwright's intention by allowing the variations of his personal temporary emotions to dominate his performance. Naturally an actor, like anyone else, is much moved by a play. He reads it, reacts to it, works into it, gets fond of it, feels that he understands it. But once that reaction to a piece of writing has "crystallized" and has become part of his experience, it is an actor's job to get that understanding over to an audience according to the author's intention. It is quite possible for an actor to be impressed and moved, or depressed and disturbed, by his own performance. But unless he detaches himself from these personal [illegible] he can never acquire the discipline which gives tempo, rhythm and balance to the production as a whole.

The acting profession has come to learn that devotion to a school of acting can hamper the flexibility necessary to meet the fresh problems presented by a new play. Acting in the commercial theatre is the composite result of individualistic processes: each actor works out his own performance, bringing such resiliency of mind as he may possess to augment his accumulated experience in solving the fresh problem presented by the new characterization. If he may have acquired a knowledge of several methods of approach, so much the easier for him to make his choice of method. But no "school" or method can rule him—it is his problem, and his choice, or his invention. Good acting, like a good play, is flesh and blood and not a bundle of tricks.

Plays are written to be seen and not to be read. They must rest on the library shelf or in the producer's file cabinet unless the acting profession has the flexibility to give them visual presentation, no matter how new the form or how bizarre the requirement. The playwright is the motive force; the acting is the essential means of communication between author and audience, and not an end in itself, as in the outmoded "vehicle" play. It matters little whether acting be termed a "creative" or an "interpretive" ingredient of the theatre It is likely to be a skillful fusion of both. The balance will be one way or the other, depending on what a given play requires of the actor. Each acting part presents a unique problem for which the actor must be prepared, and to overcome which he must find himself unconfined by any theory. For instance, given an author of technical capacity, whose dramatic thesis is clearly developed, whose character structure has clarity, the acting is a matter of honest interpretation. Thus would the play be presented to the public as the playwright intended. But it is not usually so easy. Gaps left by the author, intentionally or unintentionally, must be filled in by the actor. An underwritten character can come to life on the stage because an actor is sufficiently flexible, not only to interpret, but to add his own creation.

The working out of the finished product which is today's commercial "theatre," has no rule of thumb for anything connected therewith, least of all for the acting Shakespeare, as usual, said it first To the actors, Hamlet says, "Let your discretion be your tutor" Each new play presents new problems to the actor, new decisions as to interpretation or creation How these problems are solved, what considerations prevailed, how dramatic balance was attained to the satisfaction of author, producer, director and actor, and maintained for a long run, is something which no one on the outside of any given production can know. Nor will study of any number of productions furnish a sound basis for generalization on "acting." The fundamental of good acting is the sustained illusion of originality and [illegible] actor who survives in his profession has built up, bit by bit, out of experience and temperament unique to him, his own means of sustaining that illusion. *See* also THEATRE *Direction and Acting; The Actor.*

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**ACTINIC RAYS,** ultra-violet rays which produce chemical changes. The term is sometimes popularly applied to the ultra-violet rays which are invisible, but can be detected by their action on a photographic plate and by rendering certain substances fluorescent (*see* FLUORESCENCE AND PHOSPHORESCENCE). They are, to a certain extent, absorbed by the atmosphere, and, in moderate doses, have a beneficial effect on man. (*See* SPECTROSCOPY; LIGHT AND RADIATION IN RELATION TO HEALTH.)

**ACTINIDIACEAE,** a family of dicotyledonous plants, segregated from the Dilleniaceae. But four genera are recognized, the larger ones being *Actinidia,* scandent shrubs, with about 25 species, chiefly Asiatic, a few now cultivated in Europe and in the United States, the allied *Clematoclethra,* 12 species, also Asiatic, and the very large pantropic genus *Saurauia* with more than 300 species, all shrubs or small trees, characteristic of the tropics of both hemispheres. *See* E. Gilg and E Wedermann, in Engler. *A. Nat. Pflanzenfam.* ed. 2, 21:36–47. f. 26–29 (1925).

**ACTINIUM.** The metallic element actinium has the symbol Ac, atomic number 89, atomic weight 227, is exclusively trivalent, and is radioactive, the fourth member of the natural, 4n + 3 radioactive family. It occurs in uranium ores and can be manufactured from radium by transmutation in nuclear chain reactors (*see* RADIOACTIVITY, NATURAL). (G. T. SG.)

**ACTINOMETER,** an instrument for measuring the heating and chemical effects of light. It is derived from the Greek, ἀκτίς ray, μέτρον measure. The name was first given by Sir John Herschel to an apparatus for measuring the heating effect of solar rays; Herschel's instrument has been discarded in favour of the pyrheliometer (Gr. πῦρ fire, ἥλιος sun). (*See* RADIATION, RAYS.)

The word actinometer is usually applied to instruments for measuring the *actinic* or chemical effect of luminous rays; their action generally depends upon photochemical changes. A type of actinometer is used in photography under the name of exposure-meter. In this instrument a section of sensitized bromide is exposed for a measured period of time. Certain practical forms are described in the article PHOTOGRAPHY.

**ACTINOMYCOSIS** (STREPTOTRICHOSIS), a chronic infective disease occurring in both cattle and man. In both these groups it presents the same clinical course, being characterized by chronic inflammation with the formation of granulomatous tumours, which tend to undergo suppuration, fibrosis or calcification. It used to be believed that this disease was caused by a single vegetable parasite, the ray fungus, but there is now an overwhelming mass of observations to show that the clinical features may be produced by a number of different species of parasites, for which the generic name Streptothrix is adopted.

**Pathological Anatomy.**—The naked-eye appearance of the different organs affected by Streptothrix infection varies according to the duration and acuteness of the disease. In some tissues the appearance is that of a simple inflammation, whereas in others

it may be characteristic. The liver when affected shows scattered foci of suppuration, which may become aggregated into spheroidal masses, surrounded by a zone of inflammation. In the lungs the changes may be any that are produced by the following conditions: (1) An acute bronchitis. (2) A phthisical lung, grey nodules being scattered here and there almost exactly simulating tuberculous nodules. (3) An acute broncho-pneumonia with some interstitial fibrosis, and a tendency to abscess formation. The most characteristic lesions are in the skin.

The disease is more common in males than in females, and more prevalent in Germany and Russia than in England. The infection is probably spread by grain (corn or barley), on which the fungus may often be found. In a great number of recorded cases the patient has been following agricultural pursuits. The disease can only be transmitted from one individual to another with considerable difficulty, and no case of direct transmission from animal to man has yet been noted.

**Clinical History.**—The course of actinomycosis is usually a chronic one, but occasionally the fungus gets into the blood, when the course is that of an acute infective disease or even pyaemia. The symptoms are entirely dependent on the organ attacked, and are in no way specially characteristic. During life a diagnosis of phthisis is continually made, and only a microscopic examination after death renders the true nature of the disease apparent. The nature of the skin lesion is the most evident, and here the parasite may be detected early in the illness. The only drug which appears to have any beneficial influence on the course of the disease is potassium iodide, and this has occasionally been used with great benefit. Surgical interference is usually needed.

**ACTINOTHERAPY:** *see* LIGHT AND RADIATION IN RELATION TO HEALTH.

**ACTION:** *see* PRACTICE AND PROCEDURE.

**ACTIUM** (mod. PUNTA), the ancient name of a promontory in the north of Acarnania (Greece) at the mouth of the Sinus Ambracius (Gulf of Arta) opposite Nicopolis, built by Augustus on the north side of the strait.

On the promontory was an ancient temple of Apollo Actius, which was enlarged by Augustus, who also, in memory of the battle, instituted or renewed the quinquennial games called *Actia* or *Ludi Actiaci*. Actiaca Aera was a computation of time from the battle of Actium.

There was on the promontory a small town, or rather village, also called Actium.

**History.**—Actium belonged originally to the Corinthian colonists of Anactorium, who probably founded the worship of Apollo Actius and the *Actia*. In the 3rd century it fell to the Acarnanians, who subsequently held their synods there. Actium is chiefly famous as the site of Octavian's decisive victory over Mark Antony (Sept. 2, 31 B.C.). This battle ended a long series of ineffectual operations. The final conflict was provoked by Antony, who is said to have been persuaded by Cleopatra to retire to Egypt and give battle to mask his retreat; but lack of provisions and the growing demoralization of his army would sufficiently account for his decision. The fleets met outside the gulf, each over 200 strong (the totals given by ancient authorities are very conflicting). Antony's heavy fighting craft endeavoured to close and crush the enemy with their artillery; Octavian's light and mobile craft made skilful use of skirmishing tactics. During the engagement Cleopatra suddenly withdrew her squadron and Antony slipped away behind her. His flight escaped notice, and the conflict remained undecided until Antony's fleet was set on fire and thus annihilated.

**ACTIVISM** denotes any view that lays stress on action and its requirements. In psychology it means the view that stresses the importance of conation rather than cognition (*see* ATTENTION; CONATION; PSYCHOLOGY). In philosophy it denotes the view which makes utility the test of truth (*see* PRAGMATISM), or allows moral claims to justify certain theoretical assumptions (*see* KANT), or conceives of the ultimate principle of reality as some kind of will or activity (*see* ACTUALITY THEORY; SCHOPENHAUER; SPINOZA). In science it means the view which emphasizes the importance of the practical application of scientific discoveries—"knowledge is power" (*see* BACON, FRANCIS)

**ACT OF PARLIAMENT.** An act of parliament may be regarded as a declaration of the legislature, enforcing certain rules of conduct, or defining rights and conferring them upon or withholding them from certain persons or classes of persons. Acts of Parliament fall into two classes—"Public" and "Private." The former are officially defined in the Commons' Manual of Procedure as having for their object "to alter the general law," the latter, "to alter the law relating to some particular locality, or to confer rights on or relieve from liability some particular person or body of persons." The collective body of such declarations constitutes the statutes of the realm or written law of the British nation, in the widest sense, from Anglo-Saxon times to the present day. It is not, however, till the earlier half of the 13th century that, in a more limited constitutional sense, the statute-book is generally held to open, and the parliamentary records only begin to assume distinct outlines late in the reign of Edward I. It gradually became a fixed constitutional principle that an act of parliament, to be valid, must express concurrently the will of the entire legislature. It was not, however, till the reign of Henry VI. that it became customary, as now, to introduce bills into parliament in the form of finished acts; and the enacting clause, regarded by constitutionalists as the first perfect assertion, in words, of popular right, came into general use as late as the reign of Charles II. It is thus expressed in the case of all acts other than those granting money to the Crown:—"Be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal and Commons in this present Parliament assembled, and by the authority of the same." In the very rare cases where bills have been enacted under the Parliament Act in opposition to the will of the Lords, the formula is varied, the words "Lords Spiritual and Temporal" being omitted, and the word "Commons" being followed by "in accordance with the provisions of the Parliament Act." Where the act is a money grant the enacting clause is prefaced by the words, "Most Gracious Sovereign, we, Your Majesty's most dutiful and loyal subjects, the Commons of the United Kingdom of Great Britain and Northern Ireland, in Parliament assembled, towards making good the supply which we have cheerfully granted to Your Majesty in this session of Parliament, have resolved to grant unto Your Majesty the sums hereinafter mentioned; and do therefore most humbly beseech Your Majesty that it may be enacted, etc." Originally the collective acts of each session formed but one statute, to which a general title was attached, and for this reason an act of parliament was up to 1892 generally cited as the chapter of a particular statute, *e.g.*, 24 and 25 Vict. c. 101. Titles were, however, prefixed to individual acts as early as 1488. Now, by the Short Titles Act 1892, it is optional to cite the most important acts to that date by their short titles, either individually or collectively. Most modern acts have borne short titles independently of the Act of 1892. (*See* PARLIAMENT; STATUTE.)

**ACT OF STATE,** a term in law which may be generically described as an act of the Crown, or of some officer whose act is ratified by the Crown, which the courts will treat as conclusive and binding on them in any litigation before them. Such a defence or plea in bar can never be raised by the Crown against the subject except in respect of the exercise of the prerogative in international relations. For a full exposition of the subject, *see* STATE, ACT OF; and STATE SUCCESSION.

**ACTON, JOHN EMERICH EDWARD DALBERG ACTON,** 1ST BARON (1834–1902), English historian, only son of Sir Richard Acton, 7th baronet, and grandson of the Neapolitan admiral, Sir J. F. E. Acton, 6th baronet (*q.v.*), was born at Naples on Jan. 10, 1834. Coming of a Roman Catholic family, young Acton was educated at Oscott till 1848, under Dr. (afterwards Cardinal) Wiseman, and then at Edinburgh, and at Munich under Döllinger, whose lifelong friend he became. He had wished to go to Cambridge, but for a Roman Catholic this was then impossible. By Döllinger he was inspired with a deep love of historical research and a profound conception of its functions as a critical instrument. He began at an early age to

collect a magnificent historical library, with the object, never in fact realized, of writing a great "History of Liberty." In politics he was always an ardent Liberal. He spent much time in the chief intellectual centres of Europe and in the United States, and numbered among his friends Montalembert, De Tocqueville, Fustel de Coulanges, Bluntschli, von Sybel and Ranke. In 1859 Sir John Acton was returned to the House of Commons for Carlow and became a devoted admirer and adherent of Mr. Gladstone; but he was practically a silent member, and his parliamentary career came to an end in 1865. Meanwhile he had become editor of the Roman Catholic monthly paper, the *Rambler,* in 1859, on J. H. Newman's retirement from the editorship; and in 1862 he merged this periodical in the *Home and Foreign Review.*

Though a sincere Roman Catholic, his whole spirit as a historian was hostile to ultramontane pretensions, and his independence of thought and liberalism of view brought him into conflict with the Roman Catholic hierarchy. As early as Aug. 1862 Cardinal Wiseman publicly censured the *Review;* and when in 1864, after Döllinger's appeal at the Munich Congress for a less hostile attitude towards historical criticism, the pope issued a declaration that the opinions of Catholic writers were subject to the authority of the Roman congregations, Acton stopped the publication of his monthly periodical. He continued, however, to contribute articles to the *North British Review.* In 1865 he married the Countess Marie, daughter of the Bavarian Count Arco-Valley, by whom he had one son and three daughters. In 1869 he was raised to the peerage by Gladstone as Baron Acton; he was an intimate friend and constant correspondent of the Liberal leader, and the two men had the very highest regard for each other. Matthew Arnold used to say that "Gladstone influences all round him but Acton; it is Acton who influences Gladstone."

In the great crisis in the Roman Catholic world in 1870, over the promulgation by Pius IX. of the dogma of papal infallibility, Lord Acton was in complete sympathy on this subject with Döllinger (*q v*). Acton did not personally join the Old Catholic seceders. In 1874, when Gladstone published his pamphlet on *The Vatican Decrees,* Lord Acton wrote during Nov. and Dec. a series of letters to *The Times,* illustrating Gladstone's main theme by numerous historical examples of papal inconsistency, but demurring nevertheless to Gladstone's conclusion. In spite of his reservations, he regarded "communion with Rome as dearer than life." Thenceforth he devoted himself to persistent reading and study, combined with social life. Little indeed came from his pen, his only notable publication being a masterly essay in the *Quarterly Review* of Jan. 1878 on "Democracy in Europe"; two lectures delivered at Bridgnorth in 1877 on "The History of Freedom in Antiquity" and "The History of Freedom in Christianity"—these last the only tangible portions put together by him of his long-projected "History of Liberty"—and an essay on modern German historians in the first number of the *English Historical Review,* which he helped to found (1886). After 1879 he divided his time between London, Cannes, and Tegernsee in Bavaria. Gladstone found him a valuable political adviser, and in 1892, when the Liberal Government came in, Lord Acton was made a lord-in-waiting. Finally, in 1895, on the death of Sir John Seeley, Lord Rosebery appointed him to the Regius Professorship of Modern History at Cambridge. His inaugural lecture on "The Study of History," afterwards published with notes displaying a vast erudition, made a great impression in the university, and the new professor's influence on historical study was felt in many important directions. He delivered two valuable courses of lectures, on the French Revolution and on Modern History; but it was in private that the effects of his teaching were most marked. The great *Cambridge Modern History,* though he did not live to see it, was planned under his editorship, and all who came in contact with him testified to his stimulating powers and his extraordinary range of knowledge. He died on June 19, 1902, being succeeded in the title by his son, Richard Maximilian Dalberg Acton, 2nd baron Acton.

Lord Acton left too little completed original work to rank among the great historians. But he was one of the most deeply learned men of his time, and he is remembered for his influence on others His extensive library, composed largely of books full of his own annotations, was bought immediately after his death by Andrew Carnegie and presented to John Morley, by whom it was forthwith given to the University of Cambridge.

*See* Herbert Paul's excellent Introductory Memoir to the interesting volume of *Lord Acton's Letters to Mrs. Drew* (1904), and the authorities cited there; also Dom Gasquet's *Lord Acton and his Circle* (1906) and a selection from his correspondence, ed by J. N. Figgis and R. V. Laurence, with introduction (1917 *seq*). *A Bibliography of the Works of Lord Acton,* by W. A. Shaw, was [illegible] Royal Historical Society in 1903. The *Edinburgh Review* of April 1903 contains a luminous essay; and a chapter on Acton appears in Bryce's *Studies of Contemporary Biography* (1903). Lord Acton's *Lectures on Modern History,* ed. by J. N. Figgis and R. V. Laurence, appeared in 1906; and his *History of Freedom and other Essays* and *Historical Essays and Studies* (by the same editors) in 1907.

**ACTON, SIR JOHN FRANCIS EDWARD,** BART. (1736–1811), prime minister of Naples under Ferdinand IV, was the son of Edward Acton, a physician at Besançon, and was born there in 1736, succeeding to the English title and estates in 1791, on the death of his cousin in the third degree, Sir Richard Acton of Aldenham hall, Shropshire. He served in the navy of Tuscany, and in 1775 commanded a frigate in the joint expedition of Spain and Tuscany against Algiers. In 1779 Queen Maria Carolina of Naples persuaded her brother the grand-duke Leopold of Tuscany to allow Acton to reorganize the Neapolitan navy. He became commander-in-chief of both services, minister of finance, and finally prime minister. His policy was devised in concert with the English ambassador, Sir William Hamilton, and aimed at substituting the influence of Austria and Great Britain for that of Spain, at Naples, and consequently involved open opposition to France and the French party in Italy. In Dec. 1798 he shared the flight of the king and queen. For the reign of terror which followed the downfall of the Parthenopean republic, five months later, Acton has been held responsible. In 1804 he was for a short time deprived of the reins of government at the demand of France; but he was soon restored to his former position, which he held till, in Feb. 1806, on the entry of the French into Naples, he had to flee with the royal family into Sicily. He died at Palermo on Aug. 12, 1811.

He left three children, the elder son, Sir Richard, being the father of the first Lord Acton. The second son CHARLES JANUARIUS EDWARD (1803–1847), after being educated in England and taking his degree at Magdalene college, Cambridge, in 1823, entered the Academia Ecclesiastica at Rome. He became the secretary of the congregation of the Disciplina Regolare, and auditor of the Apostolic Chamber under Gregory XVI., by whom he was made a cardinal in 1842. Cardinal Acton helped to secure the increase, in 1840, of the English vicariates-general to eight, which paved the way for the restoration of the hierarchy by Pius IX in 1850. He died on June 23, 1847.

**ACTON,** a municipal borough in Middlesex, England, suburban to London, 9 mi. W. of St. Paul's cathedral; served by the G.W. Ry., the L.M.S. Ry., and the London Passenger Transport board. Pop. (1951) 67,424. Area 3.6 sq mi. The borough, as constituted before the boundary adjustments of 1934, forms the Acton parliamentary division and returns one member. The best [illegible] for its name is from Oak-town, in reference to the extensive forest which formerly covered the locality. The land belonged from early times to the See of London, a grant being recorded in 1220. Henry III had a residence here. At the time of the Commonwealth Acton was a centre of Puritanism. Philip Nye (d. 1672) was rector; Richard Baxter, Sir Matthew Hale (Lord Chief Justice), Henry Fielding, the novelist, and John Lindley, the botanist (d. 1865), are famous names among residents here. Acton Wells, of saline waters, had considerable reputation in the 18th century. Acton was made a municipal borough in 1921.

**ACT ON PETITION,** the term for a part of the procedure in the British Probate, Divorce and Admiralty Division, now of infrequent occurrence. It was more freely used in the old Admiralty and Divorce courts before the Judicature Acts. (*See* DIVORCE.)

**ACTS OF THE APOSTLES.** This book of the Bible was originally the sequel of the Gospel of Luke. Its separation was due to a growing view of the Gospels as a unit of sacred records, to which *Acts* stood as appendix. Historically it is of unique interest and value. The Apocryphal Acts of certain apostles, witnessing to the impression produced by our *Acts*, only emphasize this. It is the one really primitive Church history, primitive in spirit as in substance; apart from it a real picture of the Apostolic age would be impossible. With it, the Pauline Epistles are of priceless historical value; without it, they would remain bafflingly fragmentary, often even misleading owing to their "occasional" nature and emphasis.

**Plan and Aim.**—All agree that *Acts* is the work of an author of high literary skill, and that he exercised careful selection in the use of his materials, in keeping with a definite purpose and plan. It is of moment, then, to discover what these were. Here it is not needful to go farther back than F. C. Baur and the Tubingen school, with its theory of sharp antitheses between Judaic and Gentile Christianity, of which they took the original apostles and Paul to be typical. Gradually this position underwent modifications, as it became realized that neither Jewish nor Gentile Christianity was a uniform genus, and that the apostolic leaders from the first stood for mutual understanding and unity. The Tubingen school put the needful question, but did not return the correct answer because, as Ritschl showed (*Altkath. Kirche,* 2nd ed., 1857), their premises were inadequate. Still the attitude created by the theory persists in much that is written about *Acts*. On the whole, however, scholars now look at the book more objectively and follow up the hints as to its aim given by the author in his opening paragraph (i. 1–11). Thus (1) his second narrative is the natural sequel to his first. As the earlier book set forth in orderly sequence (*καθεξῆς*) the providential stages by which Jesus was led, "in the power of the Spirit," to begin the establishment of the Kingdom of God, so the later sets forth its extension by means of His chosen representatives or apostles. (2) This involves emphasis on the identity of the power, Divine and not merely human, visible in the great series of facts from first to last; God's Spirit appears as active throughout. But further (3), the Divine energy in the disciples is conditioned by the continued influence and volition of their "Lord" at His Father's right hand in heaven: "Holy Spirit" (without the article), the holy power of His personality (*see* xvi. 7 "the Spirit of Jesus"), is the living link between His action and theirs (i 2, 4 *seq.*, 8, ii. 1 *seq.*, *cf.* Luke xxiv. 49). And (4) the scope of this action is nothing less than all mankind (ii. 5 *seq.*), especially within the Roman empire. (5) Finally, as we see from the parallel in Luke xxiv. 46–48, the divinely appointed method of victory is through suffering (Acts xiv. 22), as it was for Messiah himself. This explains the space devoted to the tribulations of His witnesses, and their constancy amid them. It forms part of the virtual *apologia* for the absence of that earthly prosperity in which the ancient mind was apt to look for Divine approval. Moreover the Church's foes were chiefly Jews, whose opposition our author regards as due to blindness to the wider reading of their own religion—to which the Holy Spirit had from of old been pointing (*cf.* Stephen's speech)—and to jealousy of those who, by preaching the wider Messianic Evangel, were winning the Gentiles, and particularly proselytes, in such numbers.

These, then, seem to be the author's main *motifs:*—the *universality of the Gospel,* the *jealousy of national Judaism,* and the *Divine initiative,* manifest particularly in the gradual stages by which men of Jewish birth were led in spite of their own prejudices, to recognize the Divine will in the setting aside of national restrictions, alien to the universal destiny of Messiah's Church. The practical moral is *the Divine character of the Christian religion,* as evinced by the manner of its extension in the empire, no less than by its original expression in the Founder's life and death. Thus both parts of the author's work alike tend to produce assured conviction of Christianity as of Divine origin (Luke i. 1, 4; Acts i. 1 *seq.*).

This view gives the book a practical religious aim—a *sine qua non* to any theory of an early Christian writing. In spite of all difficulties, this religion is worthy of belief, even though it mean opposition and suffering. To meet this source of doubt the author holds up the picture of earlier days, when the great Apostle of the Gentiles enjoyed protection at the hands of Roman justice. It is implied that the present distress is but a passing phase, resting on misunderstanding; for Christianity, as the true fulfilment of Israel's religion, had once been (and might again be) treated as a recognized or lawful (*licita*) religion, the more so that it had deep kinship with non-Jewish philosophic monotheism. Meantime the example of apostolic [illegible] inspire like fidelity. *Acts* is in fact an Apology for the Church as distinct from Judaism, the breach with which is accordingly traced with fulness and care.

From this standpoint *Acts* no longer seems to end abruptly Whether as exhibiting the Divine leading and aid, or as recording the normal attitude of the Roman State, the writer has reached a climax, "Paulus Romae, apex Evangelii" (Bengel). In keeping with this, verses 26–28 of chap. xxviii. are the solemn close of the work, while verses 30, 31 are an appended observation. Yet even here, by the final word of all "unmolested," the writer ends most fitly on one of his keynotes.

The full force of this is missed by those who, rightly rejecting the idea that he had in reserve enough history to furnish another work, hold that Paul was freed from the imprisonment in which *Acts* leaves him (*see* PAUL). For those, on the other hand, who see in the writer's own comment in xx. 38, uncontradicted by what follows, a broad hint that Paul never saw his Ephesian friends again, the view is open that his end was too well known to call for explicit record. Nor would such silence be disingenuous, any more than on the theory that martyrdom overtook him later. (The view that *Acts* was written before Paul's death is excluded by the date of Luke's Gospel ) To the writer Paul's death (like the horrors of Nero's Vatican Gardens in 64) was a monstrous exception to the rule of Roman policy heretofore illustrated. Not even by the Romans themselves were all Nero's acts regarded as precedents.

**Authorship.**—External evidence, which is early and widespread (*e.g.*, Irenaeus, Muratorian Canon, Tertullian, Clement), all points to Luke, Paul's companion, probably his physician (Col. iv. 14). Evidence for his authorship of the third Gospel counts also for *Acts*. This carries us back at least to the second quarter of the 2nd century (Justin, *Dial.* 103, and Marcion). Nor was Luke prominent enough as an associate of Paul for the belief to be a mere guess. If, then, the Lucan authorship is to be doubted, it must be on internal evidence. The form of the book, however, favours Luke, who was of non-Jewish birth (*see* Col. iv 12–14 with 10 *seq.*), and as a physician presumably a man of culture. The medical cast of some of its language points the same way. This argument, first worked out by Dr. W. K. Hobart, *The Medical Language of St. Luke* (Dublin, 1882), has been urged afresh in Harnack's *Luke the Physician* (1907), to which reference may be made for all matters connected with Lucan authorship. The early tradition that this Luke was born in the Syrian Antioch suits the way in which the origin of the Antiochene Church and its place in the extension of the Gospel are described (*see* LUKE). Again, the attitude of *Acts* towards the Roman empire is just what would be expected from a comrade of Paul, but hardly from a man who belonged to the next generation. Finally, the book itself seems to claim to be by a companion of Paul. In chap. xvi. 10 without any previous warning it passes from the third person to the first. "But when he saw the vision, straightway *we* sought to go forth into Macedonia." Thenceforth "we" reemerges at certain points in the narrative until Rome is reached. These parts at least are generally held to imply the narrative of an eye-witness. If so, this eye-witness was probably also the author of the work; for the style of the "we" passages is the same as that of the book as a whole (*see* Sir J. C. Hawkins in *Horae Synopticae,* 1899, pp. 143–147). In a word, the author of Acts was Luke, Paul's companion during most of his later ministry, and also his "counterpart," "as a Hellene who yet had personal sympathy with Jewish primitive Christianity" (Harnack, *op. cit.* p. 145; *see* also LUKE).

**Sources.**—So far from such a plan and such an author being inimical to the quest after the materials used in *Acts* one may say

that it points the way thereto, while it keeps literary analysis within scientific limits. In their light one feels that the speeches in its first part (*e g*, that of Stephen)—and indeed elsewhere, too—are not "free compositions" of our author, the outcome of dramatic idealization such as ancient historians like Thucydides or Polybius allowed themselves. The Christology, for instance, of the early Petrine speeches is such as a Gentile Christian writing c AD. 80 simply could not have imagined We are forced to assume the use of early Judaeo-Christian material, akin to that implied also in the special parts of the Third Gospel. P. Feine (*Eine vorkanonische Ueberlieferung des Lukas,* 1891) suggested that a single document explains this material in both works, as far as Acts xii. Others maintain that at any rate two sources underlie Acts i–xii, or even i.–xv. (*see* A. Harnack, *The Acts of the Apostles,* 162 *seq.* and Foakes Jackson and Kirsopp Lake, *The Beginnings of Christianity,* pt. i. vol. ii 122 *seq.*). Certainly we can discern the presence of traditions of the Jerusalem Church and of the largely Hellenistic Church of Antioch. But it remains a question whether they reached our author in written form. If he was a careful inquirer (Luke i 3), especially if he was in the habit of taking down in writing what he heard from different witnesses, this may explain the phenomena (including the alleged traces of "Aramaisms") Luke would have rare facilities for collecting Palestinian materials, varying no doubt in accuracy but all relatively primitive, whether in Antioch or in Caesarea, where he probably resided for some two years in contact with Philip the Evangelist and his daughters (xxi. 8). There and elsewhere he might also learn a good deal from John Mark, Peter's friend (I. Pet. v. 13; Acts xxi. 12).

In the second or strictly Pauline half, two main theories of the so-called "we" passages are possible: (1) that which sees in them traces of an earlier document—whether a travel-diary or a more consecutive narrative written later; and (2) that which regards the "we" as due to the author's breaking instinctively into the first person plural where he felt himself specially identified with the history. On the former hypothesis, it is still in debate whether the "we" document lies behind more of the narrative than is definitely indicated by the formula in question (*e.g.,* chaps. xiii.–xv, xxi. 19–xxvi). On the latter, the presence or absence of "we" may well be due to psychological causes, rather than to the writer's mere presence or absence. Sometimes, he may be writing as a member of Paul's mission at the critical stages of onward advance (xvi. 10 *seq.,* xx. 5 *seq.,* xxvii. 1 *seq.*); sometimes rather as a witness absorbed in his hero's words and deeds (so "we" ceases between xx. 15 and xxi. 1). In the former cases the whole "mission" was on the move.

**Historical Value.**—Questions of authorship and sources are of moment mainly as bearing on the contents as history (see *Beginnings of Christianity,* as above, pp. 265–348). *Acts* falls into two distinct parts. The first (i.–xii.) deals with the church in Jerusalem and Judaea, and with Peter as central figure—at any rate in chaps. i.–v. The difficulty here is that we have but few external means of testing the narrative (*see* further, *Date*). Some of it may have suffered partial transformation in oral tradition before reaching our author; *e.g.,* the nature of the Tongues at Pentecost does not accord with what we know of the gift of "tongues" generally. The second part pursues the history of the apostle Paul; and here we can compare it with his Epistles. The result is a general harmony, without any trace of direct use of these letters; and there are many minute coincidences. But there are also two remarkable exceptions. These are, the account given by Paul of his visits to Jerusalem in *Galatians* as compared with *Acts;* and the nature of his mission, as it appears in his letters and in *Acts.*

In regard to the first point, differences as to Paul's movements before his return to his native province of Syria-Cilicia (*see* PAUL) can be explained by the different interests of Paul and our author respectively. But what of the visits of Gal. ii. 1–10 and Acts xv.? If they refer to the same occasion, as is usually assumed, it is hard to see why Paul should omit reference to the public occasion of the visit and to the public vindication of his policy. But in fact the issues of the visits, as given in Gal. ii. 9 *seq.* and Acts xv. 20 *seq.,* are not at all the same (Harnack [*op. cit.* pp. 245 *seq*] and others vainly argue that the Abstinences defined for Gentiles were in the original text of Acts xv. 20 purely moral, and had no reference to Jewish scruples as to eating blood). Nay more, if Gal. ii. 1–10 = Acts xv, the historicity of the "Relief visit" of Acts xi. 30, xii. 25, seems excluded by Paul's narrative before the visit of Gal. ii. 1 *seq* Accordingly, Sir W. M. Ramsay and others argue that the latter visit itself coincided with the Relief visit, and see in Gal. ii. 10 witness thereto. But why, then, does not Paul refer to the *public* charitable object of his visit? It seems easier therefore to admit that the visit of Gal. ii. 1 *seq.* is one unrecorded in *Acts,* owing to its private nature as preparing the way for public developments—with which *Acts* is mainly concerned. In that case it would fall shortly before the Relief visit, to which there may be indirect explanatory allusion in Gal. ii. 10 (*see* further PAUL); and it will be shown below that such a conference of leaders in Gal. ii. 1 *seq.* leads up excellently both to the First Mission Journey and to Acts xv. (For other views *see The Beginnings of Christianity,* 273 *seq.,* 321 *seq.*)

We pass next to the Paul of *Acts.* In his epistles Paul insists that he was the apostle to the Gentiles, as Peter was to the Circumcision; and that circumcision and the observance of the Jewish law were of no importance to the Christian as such. But in *Acts* it is Peter who first opens up the way for the Gentiles. It is Peter who used the strongest language in regard to the intolerable burden of the Law as a means of salvation (xv. 10 *seq. cf* 1). Not a word is said of difference between Peter and Paul at Antioch (Gal. ii 11 *seq*). The brethren in Antioch send Paul and Barnabas up to Jerusalem to ask the opinion of the apostles and elders; they state their case, and carry back the decision to Antioch. Throughout Acts Paul never stands forth as the unbending champion of the Gentiles. He seems anxious to reconcile the Jewish Christians by personally observing the law of Moses. He circumcises the semi-Jew, Timothy; and he performs his vows in the temple. He is particularly careful in his speeches to show how deep is his respect for the law of Moses. In all this the letters of Paul are very different from *Acts.* In *Galatians* he claims perfect freedom in principle, for himself as for the Gentiles, from the obligatory observance of the Law; and neither in it nor in *Corinthians* does he take any notice of a decision reached at Jerusalem. The narrative of *Acts,* too, itself implies something other than what it sets in relief; for why should the Jews hate Paul so much, if he was not in some sense disloyal to their Law?

There is, nevertheless, no essential contradiction here, only such a difference of emphasis as belongs to the standpoints and aims of the two writers and to different historical conditions. Peter's function in relation to the Gentiles belongs to early Palestinian conditions, before Paul's distinctive mission had taken shape. Once Paul's apostolate—parallel with the more collective apostolate "the Twelve"—has proved itself by tokens of Divine approval, Peter and his colleagues frankly recognize the distinction of the two missions, and are anxious only that the two shall not fall apart by religiously and morally incompatible usages (Gal. ii. 10, *cf.* Acts xv.). Paul, on his side, clearly implies that Peter felt that the Law could not justify (Gal. ii. 15 *seq.*), and argues that it could not now be made obligatory in principle (*cf.* "a yoke," Acts xv. 10); yet for Jews it might continue for the time (pending the Parousia) to be seemly and expedient, especially for the sake of non-believing Judaism. To this he conformed his own conduct as a Jew, so far as his Gentile apostolate was not involved (I Cor. ix. 19 *seq.*). There is no reason to doubt that Peter largely agreed with him, since he acted in this spirit in Gal. ii. 11 *seq.,* until coerced by Jerusalem sentiment to draw back for expediency's sake. This incident it did not fall within the scope of *Acts* (*see* above) to narrate, since it had no abiding effect on the Church's extension. As to Paul's submission of the issue in Acts xv. to the Jerusalem conference, *Acts* does not imply that Paul would have accepted a decision in favour of the Judaizers, though he saw the value of getting a decision for his own policy in the quarter to which they were most likely to defer. If the view that he already had an understanding with the "Pillar" Apostles, as recorded in Gal. ii. 1–10 (*see* further PAUL), be correct, it gives

the best of reasons why he was ready to enter the later public Conference of Acts xv. Paul's own "free" attitude to the Law, when on Gentile soil, is just what is implied by the hostile rumours as to his conduct in Acts xxi. 21, which he was glad to disprove as at least exaggerated (*ib.* 24 and 26). What is clear is that such lack of formal accord as here exists between *Acts* and the Epistles tells against its author's dependence on the latter; and so favours his having been a comrade of Paul himself.

**Speeches.**—The speeches in *Acts* deserve special notice. Ancient historians (like many of modern times) used the liberty of working up in their own language the speeches recorded by them. They did not dream of verbal fidelity; they preferred to mould a speaker's thoughts to their own methods of presentation. Besides this, some did not hesitate, for vividness' sake, to give to their characters speeches which were never uttered. Now how far has the author of *Acts* followed these practices? Some of its speeches are evidently bare summaries. Others claim to be reports of speeches really delivered. But all have been passed through one mind, and some mutual assimilation in phraseology and idea may well have resulted They are, moreover, all of them, mere abstracts. Yet these circumstances, while inconsistent with verbal accuracy, do not destroy authenticity; and in most cases (*e.g.* xiv. 15–17) there is a varied appropriateness, as well as an allusiveness, pointing to good information (*see* under *Sources*). There is no evidence that any speech in *Acts* is the free composition of its author, without either written or oral basis, and in general he seems nearer than most ancient historians to the essentials of historical accuracy.

**Miracles.**—Objections to the trustworthiness of *Acts* on the ground of its miracles require to be stated more carefully than has usually been the case especially as bearing on authorship. For the idea of the "miraculous" or supernormal is hardly if at all, less marked in the "we" sections (where efforts to dissect it out are fruitless) than in the rest of the work. The scientific method, then, is to consider each "miracle" on its own merits, according as we may suppose that it has reached our author more or less directly. But even the form in which the gift of Tongues at Pentecost is conceived does not exclude Luke's authorship, since it may have stood in his source; and the first outpouring of the Messianic Spirit may soon have come to be thought of as unique by some Jewish Christians, parallel in form to the Rabbinic tradition as to the inauguration of the Old Covenant at Sinai (*cf.* Philo, *De decem oraculis*, 9, 11, and the Midrash on Ps. lxviii. 11).

As to such historical difficulties in *Acts* as still remain, there are various possibilities of mistake intervening between the facts and the accounts which reached its author, at second or even third hand (*see* further under *Date*). Also recent research in antiquity has tended to verify such parts of the narrative as can be tested, as Sir W. M. Ramsay in particular has shown. The proofs of trustworthiness extend also to the theological sphere. What was said of the Christology of the Petrine speeches applies to the whole conception of Messianic salvation, the eschatology, the idea of Jesus as equipped by (the) Holy Spirit for His Messianic work. These and other forms of very primitive witness in *Acts* have not indeed the value of shorthand notes or even of abstracts based thereon. But they suggest that our author gave a faithful account of such words and deeds as had come to his knowledge. The perspective of the whole is no doubt his own; and as his materials furnished but few hints for a continuous narrative, this perspective, especially in things chronological, may sometimes be faulty. Yet when one remembers that by A.D. 70–80 it must have been a matter of small interest by what *tentative* stages the Messianic salvation was first extended to the Gentiles, it is surely surprising that *Acts* enters into any detail on the subject, and is not content with a summary account such as the mere logic of the matter would naturally suggest.

"Study of Sources" (*Quellenkritik*), then, solves many difficulties in the way of treating *Acts* as an honest narrative by a companion of Paul. In addition, we may also count among recent gains a juster method of judging such a book. For among the results of the Tübingen criticism was what Dr. W. Sanday called "an unreal and artificial standard, the standard of the 19th century rather than the 1st, of Germany rather than Palestine, of the lamp and the study rather than of active life." This has a bearing, for instance, on the differences between the three accounts of Paul's conversion in *Acts*. In the recovery of a more real standard, we owe much to men like Mommsen, Ramsay, Blass and Harnack, trained amid methods and traditions other than those which had brought the constructive study of *Acts* almost to a deadlock. Nor have the results of recent similarly jealous suspicion (of which Loisy is the type) won any wide consensus among scholars.

**Date.**—External evidence points to the existence of *Acts* at least as early as the opening years of the 2nd century. The traces of it in Polycarp and Ignatius, when taken together, are highly probable; and the resemblance of Acts xiii 22, and I Clem. xviii 1, in features not found in the Psalm (lxxxix 20) quoted by each, can hardly be accidental (see *The N T. with Apostolic Fathers*, 48 *seq*). That is, *Acts* was probably current in Rome as early as *c.* A D 95. With this view internal evidence agrees. In spite of some advocacy of a date prior to A.D 70, the bulk of critical opinion is against it. The prologue to Luke's Gospel implies the dying out of eye-witnesses as a class. Many support a date about A D. 80; some prefer 75 to 80; while a date even before 75 seems possible. Of the reasons for a date in one of the earlier decades of the 2nd century, as argued by the Tubingen school, most are now untenable. Among these are the supposed traces of 2nd-century Gnosticism and "hierarchical" ideas of organization; while the argument from the relation of the Roman state to the Christians has been turned by Ramsay into proof of an origin prior to Pliny's correspondence with Trajan, *c.* 112. Another fact tells against a 2nd-century date, *viz.* the failure of a writer devoted to Paul's memory to avoid seeming conflict with his Epistles. If, indeed, *Acts* uses the later works of Josephus, we should have to place it about A D. 100. But this is far from proved.

Three points of contact with Josephus in particular are cited (1) The circumstances attending the death of Herod Agrippa I in A D 44. Here Acts xii. 21–23 is largely parallel to Jos. *Antt* xix 8. 2, but the latter adds an omen of coming doom, while *Acts* alone gives a circumstantial account of the occasion of Herod's public appearance. Hence the parallel, when analysed, tells against dependence. So also with (2) the case of the Egyptian pseudo-prophet in Acts xxi. 37 *seq.*, Jos. *Jewish War*, ii. 13 5, *Antt.* xx. 8. 6; for the numbers do not agree with either of Josephus's rather divergent accounts, while *Acts* alone speaks of *Sicarii* With these instances in mind, it is best to regard (3) the curious resemblance in v 36 *seq* and Jos. *Antt.* xx. 5. 1 as to the order in which Theudas and Judas of Galilee are referred to in both as accidental, the more so that again there is difference as to numbers. There may well have been another Theudas, in the period of many tumults after the death of Herod the Great to which Josephus refers in *Antt.* xvii. 10. 4, whom as a pseudo-Messiah on so small scale he might not think worth while mentioning after A.D. 70; whereas to Gamaliel the case was not long before his own time ("before these days"). Further, to make out a case for dependence, one must assume the mistaken order in Gamaliel's speech as due to gross carelessness in the author of *Acts* Such a mistake, if really there, was far more likely to arise in oral transmission of the speech, before it reached Luke at all.

**Place.**—The place of composition is still an open question. Rome and Antioch have been in favour; and Blass combined both views in his theory of two editions (*see* further, *Text*). But internal evidence points to the Roman province of Asia, and the neighbourhood of Ephesus. Note the confident local allusion in xix. 9 to "the school of Tyrannus"—not "a certain Tyrannus," as in the inferior text—and in xix. 33 to "Alexander"; also the very minute topography in xx. 13–15. Affairs in that region, including the future of the church of Ephesus (xx. 28–30), are treated as though they would specially interest "Theophilus" and his circle: also an early tradition makes Luke die in the adjacent Bithynia. An *apologia* for the Church against the Synagogue's attempts to influence Roman policy to its harm would be much to the point in "Asia" (*cf.* Rev. ii. 9, iii. 9, and Sir W. M. Ramsay, *The Letters to the Seven Churches*, ch. xii.).

**Text.**—The *apparatus criticus* of *Acts* has grown considerably of recent years; mainly in one direction, that of the so-called "Western text." This misleading term really stands for a glossing or paraphrastic text, comparable to a Targum on an Old Testament book, which became very widespread, in both east and west, for some 200 years or more from early in the 2nd century. The sifting, however, of the readings in all our witnesses (mss., versions, Fathers) has not yet gone far enough to yield final results as to the history of this text—what in its extant forms is primary, secondary, and so on. Beginnings only have been made towards grouping our authorities (see J. H. Ropes' fine study in *Beginnings of Christianity*, pt. i., vol. iii. pp. ccxv.). Assuming, however, that the original form of the "Western" text had been reached, the question of its historical value, *i.e.* its relation to the original text of *Acts*, would remain On this point the highest claims were made by Blass (1894 and later), who held that both the "Western" text of *Acts* (styled the $\beta$ text) and its rival, the text of the great uncials (the $\alpha$ text), are due to the author's own hand; and that the former (Roman) is more original than the latter (Antiochene); but the theory (as Ropes shows) is untenable. Sir W. M. Ramsay pointed the way to sounder views. Already in *The Church in the Roman Empire* (1893) he held that the "Western" text in the *Codex Bezae* rested on a recension made not later than about the middle of the 2nd century. Though "some at least of the alterations in *Codex Bezae* arose through a gradual process," the revision as a whole was the work of a single reviser. His aim, in suiting the text to the views of his place and time, was to make it at once more intelligible and more complete. In his later work, *St. Paul the Traveller and the Roman Citizen* (1895), Ramsay's views gained in breadth by looking beyond the Bezan text to the "Western" text as a whole.

But all earlier work on the text of *Acts* is summed up and improved in Ropes' monumental edition (as above). Generally speaking, the text as printed by Westcott and Hort, on the basis of the earliest mss. (ℵB), seems in *Acts*, as elsewhere, to be nearest to the autograph: the "Western" text, even in its earliest form, was a deliberate revision. This does not mean that it has no historical value of its own. Certain of its readings (*e.g.* xi. 28, xii. 10) may even date from the end of the 1st century and preserve living memories. But their value is mainly that of an early commentary, and lies in the light cast on ecclesiastical thought in certain quarters and epochs. *Acts*, from its very scope, was least likely to be viewed as sacrosanct in its text. Indeed there are signs that its undogmatic nature caused it to be comparatively neglected at certain times and places, as, *e.g.*, Chrysostom explicitly witnesses.

BIBLIOGRAPHY.—An account of the extensive literature that has gathered round *Acts* may be found in R. J. Knowling's ed. in *The Expositor's Greek Testament* vol. ii. (1900), and in his *Testimony of St Paul to Christ* (1905); C. Clemen, *Die Apostelgesch. im Lichte der neueren Forschungen* (Giessen, 1905); A. Harnack, *Acts of the Apostles* (1909); J. Moffatt's *Introduction to the N.T.* (1911 and [illegible] Foakes Jackson and Kirsopp Lake, *The* [illegible] pt. i. (1920–28); H. J. Cadbury, *The* [illegible] *Luke-Acts* (1927). (J. V. B.)

**ACTUALITY THEORY** is the view that the real is not a thing or a state at rest, but an activity or a process.

In philosophy the theory is as old as Heraclitus who conceived ultimate reality as an incessant becoming, not as static being. In modern philosophy Spinozism may be regarded as a form of this theory. For, notwithstanding the important place which the conception of "substance" holds in the philosophy of Spinoza, Spinozism when correctly interpreted is essentially dynamic, not static, in character. Of subsequent philosophers the following (among others) may be regarded as upholders of the actuality theory in some form or other. Fichte conceived of the real as the infinite activity of the absolute ego. Hegel regarded it as an absolute process, a kind of dialectical evolution. Schopenhauer described it as volitional activity or striving. Wundt likewise thought of reality as a complex of volitional activities or processes. For Bergson "there are no things, only activities" (*Creative Evolution*). Of philosophical men of science Mach, Ostwald, and Whitehead (among others) may be claimed as supporters of the actuality theory. Indeed the whole drift of present day science is to regard "events" rather than "things" as the ultimate components of the world of reality.

In psychology the actuality theory is mainly concerned with the nature of the soul or mind. According to the popular view, which is also supported by many psychologists, the mind or soul is a substance, an abiding something which owns the mental experiences of knowing, feeling, and willing, or which exercises these activities. As against this "substantial" view of the soul, the actuality theory in psychology treats the soul as just the complex or system of these activities, experiences, or processes, and no more. The view appears to be as old as Protagoras and Aristotle. It is quite explicit in Spinoza, for whom the human soul is just a complex of ideas, and ideas are not dead, static pictures on a canvas, but living activities. Hume likewise stated that his introspective attempt to catch a glimpse of his soul revealed to him nothing but "a bundle" of sensations, etc. Of modern psychologists, Fechner, Höffding, James, Baldwin, Ebbinghaus, Sully, and Wundt (among others) may be classed among the supporters of the actuality theory, while other psychologists are more or less in sympathy with it, though they regard the whole question as pertaining to philosophy rather than to psychology. On one point, however, all modern psychologists are agreed, namely, that mental experiences are essentially events, activities, or processes, not states. And this agreement is largely the result of the contention of the upholders of the activity theory.

**ACTUARY.** The name of *actuarius*, sc. *scriba*, in ancient Rome, was given to the clerks who recorded the *Acta Publica* of the senate, and also to the officers who kept the military accounts and enforced the due fulfilment of contracts for military supplies. In its English form the word has undergone a gradual limitation of meaning. At first it seems to have denoted any clerk or registrar; then more particularly the secretary and adviser of any joint-stock company, but especially of an insurance company; and it is now applied specifically to one who makes those calculations as to the probabilities of human life upon which the issuance of life insurance and annuity contracts depend.

In the life insurance companies of the U.S., Canada, and Great Britain, the actuarial departments are large and the position of the actuary important.

In the United States there are two scientific organizations for the promotion of actuarial science embracing members from Canada also.

One is the Actuarial Society of America, founded in 1889, with headquarters in New York. The other is the American Institute of Actuaries, founded in 1909, with headquarters in Chicago.

Admission to membership is by examination, and beginning in 1938 the two organizations adopted the practice of having identical examinations, set by a joint committee. The mathematical parts of the examinations include advanced algebra with special emphasis upon the theory of probability, the theory of compound interest, finite differences, the differential and integral calculus, and statistics. The other parts of the examinations include the application of mathematics to life contingencies, the compilation of tables of mortality, disability, sickness, accident, etc., the underwriting of risks, life insurance accounting, the theory of banking and finance, the investment of life insurance funds, and the law as it relates to life insurance contracts.

In Great Britain there are two actuarial organizations—one, the Institute of Actuaries founded in 1848, with headquarters at Staple Inn Hall, London, and the other, the Faculty of Actuaries, founded in 1856, with headquarters in Edinburgh. Both are incorporated by royal charters and admission to each is by examination.

In 1895 the first International Congress of Actuaries was held in Brussels.

(*See* also INSURANCE, ARTICLES ON.) (M. A. L.)

**ACUÑA, CHRISTOVAL DE** (1597–*c.* 1676), Spanish Jesuit missionary and explorer, was born at Burgos in 1597. He was sent on mission work to Chile and Peru, where he became rector of the college of Cuenca. In 1639 he accompanied Pedro Texiera in his second exploration of the Amazon, in order to take scientific observations, and draw up a report for the Spanish Government. The journey lasted ten months; on the explorer's

arrival in Peru, Acuña prepared his narrative, while awaiting a ship for Europe. The king of Spain, Philip IV., received the author coldly, and it is said even tried to suppress his book, fearing that the Portuguese, who had just revolted from Spain (1640), would profit by its information. Eventually Acuña returned to South America, where he died, probably soon after 1675. His *Nuevo Descubrimiento del Gran Rio de las Amazonas* was published at Madrid in 1641; French and English translations (the latter from the French), appeared in 1682 and 1698.

**ACUPRESSURE,** the name given to a method of stopping bleeding from an artery by passing a needle through the tissue so that the vessel is compressed. A loop of wire may be passed around the free ends of the needle so that there is more pressure. The method was advocated by Sir J. Y. Simpson.

**ACUPUNCTURE,** a form of surgical procedure, performed by pricking the part affected with a needle. It has long been used by the Chinese in cases of headaches, lethargies, convulsions, colics, etc. It is also used to obtain fluid, through a hollow needle, for its help in making a diagnosis. It is known as tapping.

**ADA,** a village of Hardin county, O., U.S., on the Pennsylvania railroad, 15 mi. E. of Lima. Pop. (1950) 3,629; it lies on the watershed between the Ohio river and the Great Lakes, in a rich agricultural district.

Chief manufactures are athletic goods, sheetmetal products, lumber and flour. The village is the seat of the Ohio Northern university (Methodist).

**ADA,** a city of Oklahoma, 85 mi. S.E. of Oklahoma City; served by the Santa Fe, the Frisco and the Oklahoma City-Ada-Atoka railways. Pop. (1950) 15,935. Ada is the county seat of Pontotoc county, which produces natural gas and petroleum, cotton, grain, livestock, sweet potatoes, peanuts and alfalfa; and has deposits of rock asphalt, glass sand, pottery clay, lead, zinc and other minerals. The city has cotton gins and compresses; feed and corn mills; cement, stone crushing, pottery and glassworks; brickyards and grain elevators. It is the seat of the East Central State college (1909). The city was incorporated in 1901. It has a council-manager form of government.

**ADAB** (modern BISMAYA), an ancient town in Mesopotamia, in 32° N., 45° 30′ E., 25m. S. of Nippur. It was supplied by a canal which passed through the city and irrigated the country, eventually falling into the Shatt al Hai. In the centre of the city the canal divided to form an island on which stood the temple of the mother Goddess Aruru, to whose cult the city was devoted. There are a succession of periods on the mound which rises 50ft. above the plain: 2 to 3 ft. below the platform of Ur Engur are the buildings of the kings of Akkad; 10ft. below are the plano-convex bricks of Unnina; 10ft. lower are buildings made of limestone blocks, which were used before the days of brickmaking. At a depth of 48ft. the excavators found thin unpainted wheel-made pots. The Ziggurat or temple tower is pre-Sargonic and one of the oldest in Sumer. One of the most remarkable finds was the head of a Semite in white marble.

The city appears to have enjoyed a restricted independence at the time of the kings and patesis of Lagash. The kings of Akkad and Ur certainly devoted a good deal of attention to the city, probably owing to its religious cults.

*See* E. J. Banks, *Bismaya or the Lost City of Adab* (1912); S. Langdon, in *Cambridge Ancient History*, vol i. 1923.

**ADABAZÁR** or ADAPAZARI, an important commercial town in the Izmir vilayet of Turkey, situated on the old military road from Constantinople to the east, and connected by a branch line with the Anatolian railway. Pop. (1945) 29,386. There are silk and linen industries and an export of tobacco, walnut-wood, cocoons and vegetables for the Istanbul market.

*See* V. Cuinet, *Turquie d'Asie* (Paris, 1890–1900).

**ADAD,** the name of the storm-god in the Babylonian-Assyrian pantheon, who is also known as Ramman ("the thunderer"). It seems that Ramman was the name current in Babylonia, whereas Adad was more common in Assyria. A god Hadad, a prominent deity in ancient Syria, is identical with Adad, whose name is therefore, an importation into Assyria from Aramaic districts. Ramman is identical with Rimmon, known to us from the Old Testament as the chief deity of Damascus. The cult of a specific storm-god in ancient Babylonia is vouched for by the occurrence of the sign Im—the "Sumerian" for Adad-Ramman—as an element in proper names of the old Babylonian period. Through Aramaic influences in Babylonia and Assyria he was identified with the storm-god of the western Semites. The designation Amurru is also given to this god in the religious literature of Babylonia, which describes him as belonging to the Amorite district.

On the one hand he brings on the rain in due season, and causes the land to become fertile; on the other hand, by the storms that he sends, he brings havoc and destruction. He is pictured on monuments and seal cylinders with the lightning and the thunderbolt, and in the hymns the sombre aspects of the god on the whole predominate. His association with the sun-god, Shamash, imbues him with some of the traits belonging to a solar deity. In the theological lists he follows Shamash. At Erech in the south and Assur in the north Adad is intimately associated with Anu, the sky god. In Syria Hadad is hardly to be distinguished from a solar deity. In Babylonia and Assyria Shamash and Adad became in combination the gods of oracles and of divination in general. In the annals and votive inscriptions of the kings, when oracles are referred to, Shamash and Adad are always named as the gods addressed, and their ordinary designation in such instances is *bēlē biri,* "lords of divination." The consort of Adad-Ramman is Shala, while as Amurru his consort is called Ashratum.

In magic rituals the symbol of Ramman is the cypress, and his sacred number is "six," consequently the sixth day of each month was sacred to him. The principal seat of the old Sumero-Babylonian cult of the thunder god was *Muru* (ki), which has not been located, and the cult is mentioned in connection with the cities Padda, Akus, Simurri and Halbaba, all unknown and certainly unimportant places; but a great temple to him and Anu has been excavated at Assur.

*See* the special study on this deity by Hans Schlobies, *Das akkadische Wettergott in Mesopotamien* (1925); also the article BABYLONIAN AND ASSYRIAN RELIGION.

**ADAEV,** now Chapaev, region of the Kazakh Soviet Socialist Republic. Area 117,114 sq.mi. Pop. 136,000 (urban 3,012). The area includes the Ust Urt plateau (700 ft.) in the south, and the low plain to the north of it which apparently once linked the Caspian and Aral seas, and which is studded with salt lakes with [illegible] evidence of this link. The soil is either gravelly and stony desert or alkaline and gypsiferous gray soil, so that vegetation is sparse. The nomad Kirghiz tribes are mainly herdsmen. The administrative centre is Chapaev. Fort Shevchenko, formerly Alexandrovsk on the Mangishlak peninsula, has a fishing industry (including seal fishery) and exports Glauber salts obtained from the shores of Kara Bugaz bay. On Mangishlak peninsula there is evidence of naphtha, ozokerite and bitumen deposits; also coal deposits were found there in 1940. In the northwest the province extends northward in a narrow strip nearly to lat. 50° N., and thus includes the naphtha area round Uilsk, where the population is mainly Russian and Tatar. Apart from this strip, the region is semi-desert; there is no railway.

**ADAGIO,** a term in music to indicate slow time; also a slow movement in a symphony, sonata, etc., or an independent piece, such as Mozart's pianoforte, "Adagio in B minor." The diminutive form *adagietto* means somewhat less slow than *adagio.*

**ADAIR, JOHN** (d. 1722), Scottish surveyor and map-maker of the 17th century. In 1703 he published the first part of his *Description of the Sea-coasts and Islands of Scotland,* for the use of seamen. The second part never appeared. Some of his work is preserved in the Advocates' Library (now the National Library of Scotland) at Edinburgh and in the King's Library of the British Museum, London.

**ADALBERON** or **ASCELIN** (d. 1030 or 1031), French bishop and poet, studied at Reims and became Bishop of Laon in 977. When Laon was taken by Charles, Duke of Lorraine, in 988, he was put into prison, whence he escaped and sought the

protection of Hugh Capet, King of France. Winning the confidence of Charles of Lorraine and of Arnulf, Archbishop of Reims, he was restored to his see, but he betrayed Laon, together with Charles and Arnulf, into the hands of Hugh Capet. He died on July 19, 1030 or 1031 Adalberon wrote a satirical poem in the form of a dialogue dedicated to Robert, King of France, in which he showed his dislike of Odilo, Abbot of Cluny, and his followers, and his objection to persons of humble birth being made bishops. The poem was first published by H Valois in the *Carmen panegyricum in laudem Berengarii* (Paris, 1663), and in modern times by J. P Migne in the *Patrologia Latina,* tome cxli. (Paris, 1844). Adalberon must not be confounded with his namesake, Adalberon, Archbishop of Reims (d 988 or 989).

BIBLIOGRAPHY—*See* Richer, *Historiarum libri iii. et iv.* which appears in the *Monumenta Germaniae historica, Scriptores* Band iii (Hanover and Berlin, 1826–92). A. Olleris, *Oeuvres de Gerbert pape sous le nom de Sylvestre II.* (Paris, 1867); *Histoire littéraire de la France,* tome vii. (Paris, 1865–69).

**ADALBERT** (*c.* 700), English saint, possibly a grandson of Oswald, king of Deira, was sent with St. Willibrord on a mission to the Frisians, and is said to have been the first archdeacon of Utrecht. In about 702 he went to preach in north Holland, where he built a church at Egmont. He is supposed to have died in 705, on June 25, and until the early 18th century that day was still kept sacred to his memory, as patron saint, in the village of Egmont. A life of Adalbert was compiled in the 10th century, by some monks in the diocese of Treves, and one by a monk at Egmont in the 12th century.

**ADALBERT** or **ADELBERT** (*c.* 1000–1072), German archbishop, was the son of Frederick, count of Goseck, a member of a noble Saxon family. Adalbert stood high in the favour of Henry III., whom he accompanied on many expeditions into Hungary, Italy, Slavonia and elsewhere. It is said that he might have been made Pope but that he saw greater possibilities of power and influence in northern Germany. In 1045 he was appointed archbishop of Hamburg-Bremen, his province including the Scandinavian countries, as well as the larger part of North Germany. He moved the seat of the bishopric from Bremen to Hamburg, sent missionaries to Finland, Greenland and the Orkney Islands. and aimed at making Bremen a patriarchal see for northern Europe, with 12 suffragan bishoprics.

He consolidated and increased the estates of the church, exercised the powers of a count, denounced simony, and initiated financial reforms. The presence of this powerful and active personality was greatly resented by the Saxon duke of the north, Bernard II., who regarded him as a spy sent by Henry. Adalbert gave substantial help to the emperor in the struggle with Baldwin, count of Flanders, by concluding a treaty (1049) with Sweyn of Norway and Denmark, who sent a fleet to the Netherlands coast. The archbishop's ambition to secure ecclesiastical control of northern Europe was furthered in 1052 by a papal brief which put all the Christians of the north, from the Icelanders in the west to the Finns in the east, under the see of Bremen. Adalbert himself became papal legate for the north. For a time his ecclesiastical pretensions estranged Sweyn, but in the end the Norwegian king acquiesced.

Adalbert, who wished to free his lands entirely from the authority of the duke, Bernard II., aroused hostility by an attack on the privileges of the great abbeys, and after the emperor's death in 1056 his lands were ravaged by Bernard. He took a leading part in the government of Germany during the minority of Henry IV., and was styled *patronus* of the young king, over whom he exercised considerable influence. Having accompanied him on a campaign into Hungary in 1063, he received large gifts of crown estates and obtained the office of count palatine in Saxony. His power aroused so much opposition that in 1066 the king was compelled to assent to his removal from court. In 1069 he was recalled by Henry, when he made a further attempt to consolidate a northern patriarchate, which failed owing to the hostility of the papacy and the condition of affairs in the Scandinavian kingdoms. He died at Goslar, and was buried in the cathedral which he had built at Bremen. Adalbert was a man of large ideas and a strong, energetic character. He fortified and improved Bremen, and it was called the *New Rome* by his biographer, Adam of Bremen

*See* Adam of Bremen, *Gesta Hammenburgensis ecclesiae pontificum,* edited by J M Lappenberg, in the *Monumenta Germaniae historica, Scriptores,* Band vii. (1826–92); C. Ehrenberg, *Adalbert Erzbischof von Hamburg und die Idee eines Nordischen Patriarchats* (1854).

**ADALBERT,** originally VOYTECH (*c.* 950–997), known as the apostle of the Prussians, the son of a Bohemian prince, was born at Libice (Lobnik, Lubik). He was educated at the monastery of Magdeburg; and in 983 was chosen bishop of Prague The extreme severity of his rule repelled the Bohemians, whom he vainly strove to wean from their national customs and pagan rites Discouraged by ill success, he withdrew to Rome until 993, when, in obedience to the Pope, he returned to his own people. Finding little amendment, however, in their course of living, he returned to Rome, and obtained permission from the Pope to devote himself to missionary labours in N. Germany and Poland While preaching in Pomerania he was assassinated by a heathen priest.

*See* U. Chevalier, *Répertoire des sources historiques du moyen âge,* Bio-Bibl. (1905); Bolland, *Acta Sanctorum,* April 23; H. G. Voigt, *Adalbert von Prag* (1898), a thoroughly exhaustive monograph.

**ADALIA,** the ancient *Attaleia* (*q.v.*) (med. *Antaliyah;* the crusaders' *Satalia*), the largest seaport on the south coast of Asia Minor, Turkey, though in point of trade second to Mersina. The unsuitability of the harbour for modern steamers, the bad anchorage outside and the extension of railways from Smyrna greatly lessened its former importance as an emporium for west central Anatolia, although it retains considerable importance as the administrative capital of a rich and isolated vilayet. Adalia played a considerable part in the mediaeval history of the Levant. Kilij Arslan had a palace there The army of Louis VII sailed thence for Syria in 1148, and the fleet of Richard of England rallied there before the conquest of Cyprus Conquered by the Seljuks of Konia, and made the capital of the province of Tekké, it passed after their fall through many hands, including those of the Venetians and Genoese. before its final occupation by the Ottoman Turks under Murad II (1432). The port is served by coasting steamers of the local companies only. Adalia is an extremely picturesque, but ill-built and backward place. Population (1950) 27,478.

*See* C. Lanckoronski, *Villes de la Pamphylie et de la Pisidie,* i. (1890).

**ADAM,** the Hebrew word for "man"; when used without the article implying the human species (*e.g.,* Gen. i. 26 and the familiar phrase "son" or "sons of man," *i.e.,* a human being or human beings), with the article a human individual, corresponding generally to the Latin *homo* and the Greek *ἄνθρωπος.* (The absence of the article in Gen. ii. 20b and iii. 17 is probably accidental, being due to the vocalization of the Hebrew text, not to its original consonants.) But in Gen. ii. 25 and v. 1 it *may* be a proper name, applied to the first man created. It is certainly in this sense that the word is employed in Gen. v. 2–6, and so it has been generally used, in the popular language both of Jews and of Christians.

The narrative of Gen. i. in giving an account of the "creation" of man does not necessarily imply that a single pair only was thus formed at the first. Throughout that chapter the impression the reader receives is that a large number of individuals in each species come into being at once. This, however, in its present form, is the later of the two narratives of creation, though it is probably a revision of a very ancient tradition, going far back behind the earliest appearance of Israel as a nation, and based on that common stock of thought which spread from Mesopotamia over western Asia before the middle of the 2nd millennium B.C.

With the narrative in Gen. ii. 4–25—the earlier in its present form—the case is different. Here we have most certainly the theory that all humanity is sprung from a single pair, a "man" and his "woman." The narrative is naïve in its detail and elementary in its theology. There is no account of the creation of the earth, or speculation as to how it came into being; it is

assumed. There is, however, no life, whether animal or vegetable, and the ordinary processes of the weather have not yet begun. The clayey soil is moistened by "mist," and from this material "Yahweh," afterwards to be the God of Israel, models the figure of a man. Then He breathes into his nostrils, and so—breath being regarded as one of the primary "givers of life"—brings to life this earthen model. The next problem is what to do with this living toy, and Yahweh makes a proper home for him by planting a garden and making all kinds of useful trees grow in it. There is



AFTER A WOODCUT FROM "BERGOMENSIS, SUPPLEMENTUM CHRONICARUM," VENICE, 1492

EVE TEMPTING ADAM TO EAT THE FORBIDDEN FRUIT AND THEIR EXPULSION FROM THE GARDEN OF EDEN

more to be done, the man's needs are far from being satisfied, for he will require suitable companionship. It is not enough that he should exist alone, and experiment alone can show what will satisfy him.

Yahweh's first attempt at providing a suitable companion follows the method by which the man himself has been made. All kinds of forms are modelled from the wet clay, and brought before the man. At the sight of each he makes some sound, and the sound, expressing as it does the man's attitude towards the creature, becomes its name. But in no case does the name thus spontaneously given suggest that the problem is solved; the experiment has failed. Another method must be tried. Yahweh throws the man into an anaesthetic slumber and takes a rib from his side, carefully mending the place afterwards. Then He "builds" the rib into a form, and brings that to the man. Now he exclaims "wo-man," and the terms in which he greets the new figure show that at last the experiment is successful. Ultimately from this pair the whole human race descends.

Here, then, we have certain theories about human nature, held by the Israelite of the middle monarchy. Though the view of God is crude and anthropomorphic, yet it is clear that He is the author of man's being. Man's nature is bipartite—it is assumed that what is true of the common ancestor will be true of all his descendants. He consists of a body, made of the same kind of material as the soil from which all things spring, together with another element, a life-soul, which does not come from the ground, but is imparted by God Himself. The difference between the sexes is recognized, as also the fact that they are mutually complementary, but the sex instinct is at present undeveloped.

Other familiar features of human life are thus left unexplained. Man no longer lives in the garden, nor finds that the soil always yields a generous response to his efforts. The sex life is strongly developed and the subordination of woman is generally recognized. The hostility between man and other creatures, especially the snake tribe, needs explanation, and all these facts are accounted for in the second narrative, that of Gen. iii, commonly described as the story of the Fall.

Such is the Biblical story of the first man, and, apart from genealogies in Gen iv. 25, v. 1–6, Chron. i. 1, he is never mentioned again by name in the Old Testament. The narrative has affinities with others known to the ancient world, and the story of the Fall, at least, has a parallel in Ez xxviii Mesopotamians told of the formation of man from clay mingled with the blood of Bel, of Adapa, who narrowly missed attaining immortality, and of Ea-bani, made by Ishtar from clay, and seduced from his wild and primitive ways by a harlot. If all these have a common source with the Biblical narrative (which is quite possible), then we are more than ever impressed with the way in which the Hebrew genius for religion transmuted them, and, in spite of the crudities of language and thought, adapted them to universal religious experience.

Later thinkers and writers greatly expanded the story, and drew from it conclusions which were originally foreign to it. Rabbinic thought ascribed to Adam before the Fall a superhuman grandeur. One legend indeed, followed in the Koran, relates that all the angels were ordered to fall down and worship Adam, and that Satan refused, on the ground that he was made of fire and the man of clay. Others ascribed to Adam's fall the mortality of the human race, though in the original story there is no suggestion that man was originally created immortal. The doctrine of hereditary guilt appeared, and has formed the basis of much Christian theology. Apart from a single reference in Jude 14 and the mention of the name in the Lucan genealogy of Christ, St. Paul is the only New Testament writer who mentions Adam He regards him as a type or summary of the whole human race in its natural state, and contrasts him and his kind with the new order of being that came into existence with Christ—"the second Adam," the originator of the higher spiritual plane. To him the "natural" man is, as to the old Hebrew, bipartite, consisting of "flesh" and "life"; the man who is in Christ has received a third element, the "Spirit" And to Pauline thought Christ is the starting point at which this third element first enters, just as the "Adam" of Gen. i.–v. is the starting point of the lower human order. (T. H. R)

**ADAM,** the name of a family of French sculptors. LAMBERT SIGISMUND (1700–1759) executed many pieces for the French royal residences and for Frederick the Great of Prussia NICOLAS SÉBASTIEN, his brother (1705–1778), was responsible for the tomb of Catherine Opalinska at Nancy. Another brother, FRANÇOIS GASPARD BALTHASAR, executed many of the monuments at Sans Souci and Potsdam.

*See* Dussieux, *Artistes français à l'étranger* (1855); Lady Dilke, *French Architects and Sculptors of the 18th century* (1900).

**ADAM, ADOLPHE CHARLES** (1803–1856), French composer of light operas which enjoyed great favour, was born in Paris July 24, 1803, and died there May 3, 1856. Boieldieu taught and encouraged him and he became in due course one of the most prolific and popular composers of his time. Of his 53 stage works *Le Postillon de Longjumeau* merits particular mention, while his ballet *Giselle* is still performed

**ADAM, ALEXANDER** (1741–1809), Scottish teacher and antiquarian, was born on June 24, 1741 near Forres, Morayshire, and died in Edinburgh on Dec. 18, 1809. He became rector of Edinburgh High School in 1768, and had among his pupils many boys who afterwards became famous, among them Sir Walter Scott, Lord Brougham, and Jeffrey. He introduced Greek into the school curriculum, and defied tradition by publishing a *Principles of Latin and English Grammar* in English instead of Latin. His best-known work is his *Roman Antiquities* (1791).

*See* A. Henderson, *An Account of the Life and Character of A. A.* (1810).

**ADAM, SIR FREDERICK** (1781–1853), British general, fought during the Napoleonic wars from Egypt, in 1801, to Waterloo; afterwards he was high Commissioner of the Ionian Isles and governor of Madras.

**ADAM, JULIETTE** (1836–1936), French writer, known also by her maiden name of Juliette Lamber, was born at Verberie (Oise) Oct. 4, 1836. She has given an account of her childhood, rendered unhappy by the dissensions of her parents, in *Le Roman de mon enfance et de ma jeunesse* (Eng. trans., 1902). In 1852 she married a doctor named La Messine, and published in 1858 her *Idées antiproudhoniennes sur l'amour, la femme et le mariage,*

in defence of Daniel Stern (Mme. d'Agoult) and George Sand On her husband's death she married, in 1868, Antoine Edmond Adam (1816–1877), prefect of police in 1870, and subsequently life-senator; and she established a salon which was frequented by Gambetta and the other republican leaders against the conservative reaction of the 'seventies. In the same interest she founded in 1879 the *Nouvelle Revue,* which she edited for the first eight years, and in the administration of which she retained a preponderating influence until 1899. She wrote the notes on foreign politics, and was unremitting in her attacks on Bismarck and in her advocacy of a policy of *revanche.* The famous *Lettres sur la politique extérieure* in this review are from her pen. Mme. Adam was also generally credited with a share in the authorship of papers on various European capitals signed "Paul Vasili." The most famous of her numerous novels is *Païenne* (1883) Her reminiscences, *Mes premières armes littéraires et politiques* (1904), *Mes sentiments et nos idées avant 1870* (1905), and later volumes in 1907, 1909 and 1910, contain much interesting gossip about her distinguished contemporaries. Mme. Adam saw the revolution of '48, the Second Empire, the Siege of Paris, the Treaty of Versailles, and lived to see the *revanche* she had fought and prayed for when the second Treaty of Versailles was signed in 1919 In her youth she had belonged to the anti-clerical Liberal Party, but in the disillusionments of her later days she moved with her time, and just as *Païenne* had reflected a free-thinking age, *Chrétienne* (1913) was a glorification of the Catholic tradition. She died on Aug. 23, 1936.

*See* W. Stephens, *Madame Adam, la grande française* (1917).

**ADAM, MELCHIOR** (d. 1622), German divine and biographer, wrote *Vitae Germanorum philosophorum* (Heidelberg-Frankfurt, 1615–20). Pierre Bayle acknowledges his debt to this work, which deals principally with German scholars of the 16th century.

**ADAM, PAUL** (1862–1920), French novelist, was born in Paris on Dec. 7, 1862, and died there on Jan. 2, 1920. He was prosecuted for his first novel, *Chair molle* (1885), but was acquitted. He collaborated with Jean Moréas in *Le thé chez Miranda* (1886), and with Moréas and Gustave Kahn he founded the *Symboliste,* coming forward as one of the earliest defenders of symbolism. Among his numerous novels should be noted *Le mystère des foules* (1895), a study in Boulangism, *Lettres de Malaisie* (1897), a fantastic romance of imaginary future politics. In 1899 he began a novel-sequence, giving the history of the Napoleonic campaigns, the restoration, and the government of Louis Philippe, comprising *La force* (1899), *L'enfant d'Austerlitz* (1901), *La ruse* (1902), and *Au soleil de Juillet* (1903). In 1900 he wrote a Byzantine romance, *Basile et Sophia.*

He was an indefatigable traveller, and in his later years much occupied with economic theory. *Le Trust* (1910) was the fruit of one of his journeys to America. Later books were *Stéphanie* (1918) and during the World War *Reims devastée* and *Le Lion d'Arras.*

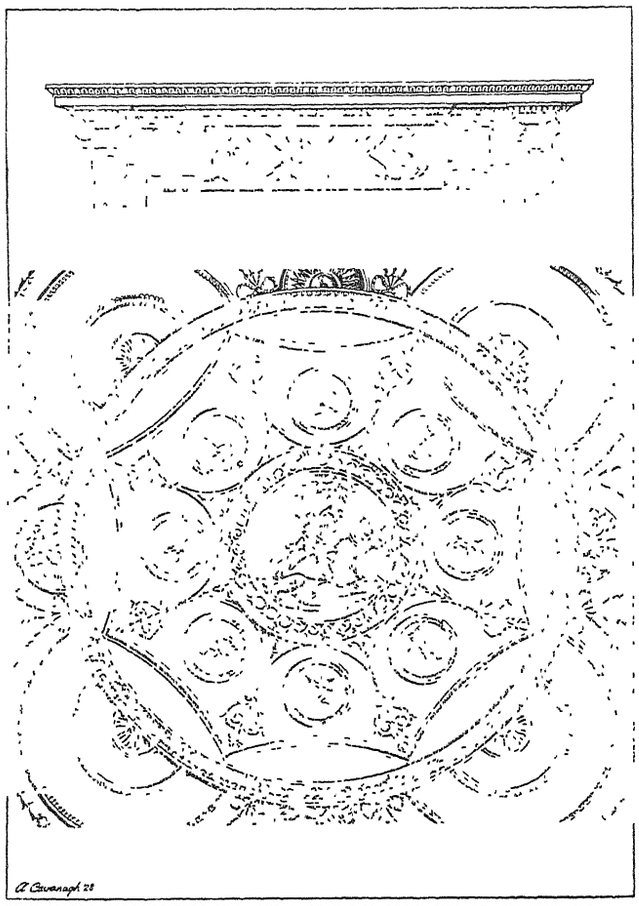
**ADAM, ROBERT** (1728–1792), British architect, the second son of William Adam of Maryburgh, in Fife, and the most celebrated of four brothers, John, Robert, James, and William Adam, was born at Kirkcaldy in 1728. He studied at the University of Edinburgh, and probably received his first instruction in architecture from his father, who gave proofs of his own skill and taste in the Edinburgh Royal Infirmary (now demolished). Somewhere between 1750 and 1754 he visited Italy, where he spent three years studying the remains of Roman architecture. There he was struck with the circumstance that practically nothing had survived of the Greek and Roman masterpieces except public buildings, and that the private palaces, which Vitruvius and Pliny esteemed so highly, had practically vanished. One example of such work, however, was extant in the ruins of Diocletian's palace at Spalato, in Dalmatia, and this he visited in July 1757, taking with him the famous French architect and antiquary, C. L. Clérisseau, and two experienced draughtsmen, with whose assistance, after being arrested as a spy, he managed in five weeks to accumulate a sufficient number of measurements and careful plans and surveys to produce a restoration of the entire building in a fine work which he published in 1764, *The Ruins of the Palace of Diocletian, etc.* Adam regarded this as the last great achievement of Roman architecture, whereas to later students it appears to mark the beginning of the decadence. The influence of these studies was apparent directly and indirectly in much of his subsequent work, which, indeed, was in great measure founded upon them.

After his return to England he came rapidly to the front, and in 1762 he was appointed sole architect to the king and the Board of Works. Six years later he resigned this office, in which he was succeeded by his brother James—who, however, held the office jointly with another—and entered parliament for the county of Kinross. In 1768 he and his three brothers leased the ground fronting the Thames, upon which the magnificent terrace of the Adelphi, one of their greatest achievements, was built for £1,200 on a 99 years' lease The Adelphi was still standing in 1928, though imminently in danger from rebuilding proposals The site presented attractive possibilities A steep hill led down Buckingham street to the river-side, and the plan was to raise against it, upon a terrace formed of massive arches and vaults and facing the river, a dignified quarter, of fine streets and stately buildings, suggestive of the Spalato ruins. Splendid, however, as the terrace and its houses are, both in conception and execution, the underground work which upholds them is perhaps more remarkable still Between 1773 and 1778 the brothers issued a fine series of folio engravings and descriptions of the designs for many of their most important works, which included several great public buildings and numberless large private houses; a fine volume was published in 1822 For the remaining years of Robert's life the practice of the firm was the most extensive in the country; his position was unquestioned, and when he died in 1792 he was laid to rest in Westminster Abbey almost as a matter of course.

As an architect, Adam was strongly under Roman and Italian influences, and his style and aims were exotic rather than native. It was the signal triumph of his genius that he was able so to mould and adapt classical models as to create a new manner of the highest charm and distinction. Out of simple curvilinear forms, of which he principally preferred the oval, he evolved combinations of extraordinary grace and variety, and these entered into every detail of his work. In his view the architect was intimately concerned with the furniture and the decorations of a building as well as with its form and construction, and this view he carried rigorously into practice, and with astonishing success. But whatever care he might have expended upon the flowing curves of a moulding or a decoration, it was strictly kept in its place; it contributed its share and no more to the total effect. He imparted the unity of a single imposing structure to a number of private houses grouped in a block which is so characteristic a feature of modern town building. A delightful but theoretically undesirable characteristic of his work is the use of stucco. Upon it he moulded delicate forms in subtle and beautiful proportions. His "compo" was used so successfully that the patent was infringed; many of his moulds still exist and are in constant use. That most difficult feature, the column, he handled with enthusiasm and perfect mastery; he studied and wrote of it with minute pains, while his practice showed his grasp of the subject by all avoidance of bare imitation of the classic masters who first brought it to perfection. His work might be classic in form but it was independently developed by himself. It would be impossible here to give a list of the innumerable works which he executed. In London, of course, the Adelphi stands pre-eminent; the screen and gate of the Admiralty and part of Fitzroy square are by him, and much of the older portion of Finsbury circus, besides whole streets of houses in the west end. There are the famous country houses of Lord Mansfield at Kenwood (Highgate) and Luton Hoo, and decorations and additions to many more.

Robert Adam—with, there is reason to suspect, some help from his brother James—has left as deep and enduring a mark upon English furniture as upon English architecture. Robert Adam was no doubt at first led to turn his thoughts towards furniture by his desire to see his light, delicate, graceful interiors, with their large

sense of atmosphere and their refined and finished detail, filled with plenishings which fitted naturally into his scheme. His own taste developed as he went on, but he was usually extremely successful, and cabinetmakers are still reproducing his most effective designs. In his furniture he made lavish use of his favourite decorative motives—wreaths and paterae, the honeysuckle and the fan ornament which he used so constantly. Thus an Adam



FROM BOLTON, "ARCHITECTURE OF R AND J ADAM," BY PERMISSION OF "COUNTRY LIFE"

A CHARACTERISTIC MANTELPIECE BY ROBERT ADAM IN THE ADELPHI. DETAIL OF ADAM DRAWING-ROOM CEILING IN GARRICK'S HOUSE, ADELPHI

house is a unique product of English art. From façade to fire-irons, from the chimneys to the carpets, everything originated in the same order of ideas, and to this day an Adam drawing room is to English what a Louis Seize room is to French art. In nothing were the Adams more successful than in the fine proportions of their mantelpieces and doors. The former, by reason of their simplicity and the readiness with which the "compo" ornaments can be applied and painted, are still made in cheap forms in great number.

John Adam succeeded to his father's practice as an architect in Edinburgh. James Adam studied in Rome, and eventually was closely associated with Robert; William is variously said to have been a banker and an architect.

*See* John Swarbrick, *Robert Adam and His Brothers* (1916); Arthur T. Bolton, *Architecture of Robert and James Adam* (1922). Both are illustrated. Mr. Bolton's book contains photographs of many Adam houses, and of many Adam interiors; among country houses, Hatchlands, Shardeloes, Harewood house, Bowood, Kedleston, Syon house and Kenwood; among the great houses of London, Lansdowne house; and many public and private buildings in Scotland.

**ADAM, WILLIAM** (1751–1839), British lawyer and politician, was a Whig and a supporter of the policy of Fox. At the English bar he obtained a very considerable practice. He was successively attorney and solicitor general to the prince of Wales, one of the managers of the impeachment of Warren Hastings, and one of the counsel who defended the first Lord Melville when impeached.

**ADAMAWA,** a region in the Sudan which lies roughly between 6° and 11° N and 11° and 15° E During the 19th century it was an independent emirate (or sultanate), but is now partitioned between British Nigeria and British and French Cameroons In all these territories administrative units with the name Adamawa survive

Adamawa owes its origin and name to Adama, a Fulani emir who established the emirate during the first half of the 19th century In 1809, under the leadership of Othman dan Fodio of Sokoto, the Moslem Fulani who had lived in the Sudan for many centuries began a holy war (*Jihad*) against the non-Moslem Negroes Adama conquered the area now known as Adamawa where he and his Fulani followers established an aristocracy controlling the many tribes such as Batta, Chamba and Lala which had opposed Fulani rule. Adama, who died in 1848, made Yola his capital and founded such cities as Garua, Ngaundere, Tibati, and placed them under the rule of Fulani emirs

Adama was succeeded by four of his sons. Lowal (1848–72) was ruling when H. Barth visited Adamawa (1851); Saanda (1872–90) consolidated the empire, Zubeiru (1890–1901) attempted to defend it against Great Britain and Germany but in 1903 he was killed by rebellious Lala when fleeing from his pursuers After Adamawa had been partitioned in 1901, Bobo Amadu, Adama's fourth son, became emir of Yola, the British section of the state.

Adamawa is a hilly region which is traversed by the Benue river Although predominantly flat (average about 1,000 ft.), there are a few high mountain groups of which Mt. Alantika (6,000 ft.) and the Mandara mountains are the most prominent The densely populated area belonging to the savanna zone is rather fertile and offers opportunities for agricultural and pastoral pursuits While the Negro groups grow durra, groundnuts, yams and cotton, the Fulani are primarily cattle breeders Hausa, Kanuri and Arabs live as traders throughout Adamawa.

(*See* also CAMEROONS; NIGERIA.)

*See* S Passarge, *Adamaua* (Berlin, 1895), K. Strumpell, *Die Geschichte Adamauas* (Hamburg, 1912); H. Barth, *Travels in North and Central Africa* (1890) (H. A WI.)

**ADAM (or ADAN) DE LE HALE** (*c* 1238–1288), French troubadour, was born at Arras. His patronymic is generally modernized to La Halle, and he was commonly known to his contemporaries as Adam d'Arras or Adam le Bossu, sometimes simply as Le Bossu d'Arras. Adam studied grammar, theology and music at the Cistercian abbey of Vaucelles, near Cambrai. He joined the household of Robert II, count of Artois, in 1272; and from 1283 was attached to Charles of Anjou, brother of Charles IX, whose fortunes he followed in Egypt, Syria, Palestine and Italy. At the court of Charles, after he became king of Naples, Adam wrote his *Jeu de Robin et Marion,* the most famous of his works. He died between 1285 and 1288. Adam's shorter pieces are accompanied by music, of which a transcript in modern notation, with the original score, is given in E. de Coussemaker's edition.

His *Jeu de Robin et Marion* is cited as the earliest French play with music on a secular subject, and on the strength of it he has been dubbed by some the father of *opéra comique* It takes the form of a dramatic pastoral introducing a number of characters and consists of a dialogue varied by refrains already current in popular song. The melodies to which these are set have the character of folk music, and are more spontaneous and melodious than the more elaborate music of his songs and motets. A modern adaptation, by Julien Tiersot, is occasionally performed. Another of his plays, *Le jeu Adan* or *Le jeu de la Feuillée* (*c.* 1262), was a satirical drama in which he introduced himself, his father and the citizens of Arras, with their peculiarities. His works include further a *Congé,* or satirical farewell to the city of Arras, and an unfinished *chanson de geste* in honour of Charles of Anjou, *Le roi de Sicile,* begun in 1282.

BIBLIOGRAPHY—The only ms. which contains the whole of Adam's work is the La Vallière ms. (No. 25, 566) in the Bibliothèque Nationale, Paris, dating from the latter half of the 13th century. Many of his pieces are also contained in Douce ms. 308, in the Bodleian library, Oxford. His *Oeuvres complètes* (1872) were edited by E. de Coussemaker. *See* J. Tiersot, *Sur le jeu Robin et Marion* (1898); L. Nicod, *Les Partures Adan, Les Jeux partis d'Adam de la*

*Halle* (1917); and, for full bibliography of works on the subject, No. 6 of the *Bibliothèque de bibliographies critiques,* by Henri Guy.

**ADAMITES** or **ADAMIANS,** a sect of heretics that flourished in North Africa in the 2nd and 3rd centuries Basing itself probably on a union of certain gnostic and ascetic doctrines, this sect pretended that its members were re-established in Adam's state of original innocency

**ADAMNAN** or **ADOMNAN** (*c.* 624–704), Irish saint and historian, was born at Raphoe, Donegal, Ireland. In 679 he was elected abbot of Hy or Iona, being ninth in succession from the founder, St Columba. In 686, while on a visit to King Aldfrith of Northumbria, he was led to adopt the Roman rules on the date of Easter and on the tonsure, but failed to enforce the change upon his monks.

We owe to Adamnan two valuable works, the anecdotic *Life of St Columba,* preserving the authentic traits of the saint, and the *De locis sanctis,* an account of Arculf's travels in the Holy Land, which, in the longer version of Bede, was a kind of guidebook to the holy places in Palestine throughout the middle ages.

Adamnan is sometimes credited with *Adamnan's Vision,* the Irish version of which is in a 12th century ms in Dublin

BIBLIOGRAPHY.—Thirteen mss of the original Arculf-Adamnan narrative exist, and fully 100 of Bede's abridgment of the former, the most important, containing all the plans, are (1) Berne, Canton library, 582, of 9th century, (2) Paris, National library, Lat 13,048, of 9th century, a third ms, London, Brit Mus, Cotton, Tib D V., of 8th–9th centuries, though damaged by fire and lacking the illustrations, is of value for the text, being the oldest of all The best edition is that of Tobler in *Itinera et [illegible] Sanctae* (1877); we may also mention that of [illegible]s *Essai sur les anciens pèlerinages à Jérusalem.* [illegible] remarks upon Arculf in the same work, 260–304, C R. Beazley, *Dawn of Modern Geography,* i, 131–41 (1897); and J L. Macpherson, *Arculfus' Pilgrimage to the Holy Land* (1899) The *Life of St. Columba* was edited by J. T. Fowler (1894).

**ADAM OF BREMEN** (died *c.* 1076), historian and geographer, was, according to one tradition, born at Meissen (Saxony) before 1045. In 1069 he appears as a canon of Bremen and master of the cathedral school On the death of Adalbert, archbishop of Bremen, in 1072, he began the *Historia Hammaburgensis Ecclesiae,* which he finished about 1075 Adam's *Historia*—known also as *Gesta Hammaburgensis Ecclesiae Pontificum, Bremensium praesulum Historia* and *Historia ecclesiastica*—is a primary authority, not only for the great diocese of Hamburg-and-Bremen, but for all north German and Baltic lands (down to 1072), and for the Scandinavian colonies as far as America.

Here occurs the earliest mention of Vinland, and here are also references of great interest to Russia and Kiev, to the heathen Prussians, the Wends and other Slav races of the south Baltic coast, as well as to Finland, Thule or Iceland, Greenland and the polar seas, which Harald III (Haardraade) and the nobles of Frisia had attempted to explore in Adam's own day (before 1066) Adam's account of north European trade at this time, and especially of the great markets of Jumne at the mouth of the Oder, of Birka in Sweden and of Ostrogard (old Novgorod?) in Russia, is also of much value.

His work, which places him among the first and best of German annalists, consists of four books or parts, and is compiled partly from written records, and partly from oral information mainly gathered from experience or at the courts of Adalbert and Sweyn II (Estrithson), king of Denmark. Of his minor informants he names several, such as Adelward, dean of Bremen, and William the Englishman, "bishop of Zealand," formerly chancellor of Canute the Great, and an intimate of Sweyn Estrithson. The fourth (perhaps the most important) book of Adam's *History,* variously entitled *Libellus de Situ Danae et reliquarum quae trans Daniam sunt regionum, Descriptio Insularum Aquilonis,* etc., has often been considered, but wrongly, as a separate work.

BIBLIOGRAPHY.—Ten mss. exist, of which the chief are (1–2) Copenhagen, Royal library, Old Royal Collection, No. 2296, of 12th to 13th cents.; No. 718, of 15th cent.; (3) Leyden university, Voss Lat. 123, of 11th cent., (4) Rome, Vatican library, 2010; (5) Vienna, Hof-u. Staatsbibliothek, 413, of 13th cent.; (6) Wolfenbüttel, Ducal library, Gud. 83, of 15th cent. There are 15 editions of the *Historia,* in whole or part, the first published at Copenhagen (1579; the first of the *Libellus* or *Descriptio Insulae Aquil* appeared at Stockholm in 1615), the best at [illegible] (1846, by Lappenberg in *Scriptores Rerum Germanicarum,* re-issued by L Weiland, 1876), and at Paris (1884, in Migne's *Patrologia Latina,* cxlvi) *See* also C R Beazley, *Dawn of Modern Geography,* ii, 514–48 (1901)

**ADAMS, ABIGAIL SMITH** (1744–1818), wife of John Adams (*q.v.*), second president of the United States, was born in Weymouth, Mass., on Nov. 23, 1744 She was the daughter of William Smith, a Congregational minister, and was descended through her mother, Elizabeth Quincy, from Thomas Shepard of Cambridge, a noted Puritan divine. Despite scanty education and delicate health, she became a terse and vigorous writer and exercised much influence on the social and political life of her time. In 1764 she was married to John Adams, then practising law in Boston. During the first ten years of this union she lived in peace and quiet, though always ardently sharing her husband's interests in the growing disputes that culminated in war In this period she became the mother of a daughter and three sons, one of whom, John Quincy Adams, rose to the presidency of the United States. But during the second ten years of married life she was practically separated from her husband, who was absent attending congress and serving on diplomatic missions in Europe. She resolutely supported him in his insistence upon the Declaration of Independence and aided him and his cause with loyal zeal.

In 1784 she rejoined her husband in France and in 1785 accompanied him to England, where, as the wife of the first minister of the United States, the then but newly lost American colonies, to the court of George III. she met with social discourtesies which she long resented From 1789 to 1801, when her husband was successively vice-president and president, she lived in a simple manner in Washington. Since the publication by C F. Adams in 1876 of *The Familiar Letters of John Adams and his Wife* increased interest has centred in the career of the stout-hearted Puritan woman who was both the wife and the mother of a president of the United States. She died at Braintree, now Quincy, Mass., on Oct. 28, 1818.

BIBLIOGRAPHY.—Laura Elizabeth Richards, *Abigail Adams and Her Times* (1917); Gamaliel Bradford, *Portraits of American Women* (1919); Dorothie Bobbé, *Abigail Adams, the Second First Lady* (1929).

**ADAMS, BROOKS** (1848–1927), U.S. historian, was born in Quincy, Mass., June 24, 1848. He graduated from Harvard university in 1870. and practised law in Boston until 1881. Thanks to a large inheritance, he had ample independent income which enabled him to travel extensively in Europe, the middle east and India. Very close to his elder brother Henry, also a historian, Brooks carried on with him an active correspondence in which they both developed the idea, revolutionary at the time, that by its nature and substance U S democracy was foreordained to degradation and decay In 1895 he published his *Law of Civilization and Decay* in which he developed his theory of history, the conviction that the centre of trade had consistently followed a westward movement from the ancient crossroads in the east to Constantinople, Venice, Amsterdam and finally London, occurring in accord with a law relating to the density of populations and the development of new and centralizing techniques of trade and industry.

His *America's Economic Supremacy* (1900) accurately foresaw within 50 years a world in which there would be only two powers, Russia and the United States, with the latter possessing economic supremacy. In 1913 he published *The Theory of Social Revolutions,* a study of defects in the American form of government, developing the idea of the imminent danger in the existence of great wealth exerting private power but declining to accept responsibility. After Henry Adams' death, Brooks Adams prepared for publication his brother's book *The Degradation of the Democratic Dogma* (1920) to which he wrote the introduction, a kind of family chronicle that began with John Quincy Adams' troubles and ended with the renunciation by the two grandsons of the democratic dogma. The roots of his Puritan ancestry were deep. An agnostic, a profound sceptic, he [illegible] last years of his life to the church at Quincy where, overcoming his lifelong shyness, he stood up and made a

public profession of his faith. Brooks Adams died in Boston, Feb. 13, 1927.

Adams' other writings include *The Emancipation of Massachusetts: The Dream and the Reality* (rev. ed., 1919); *The New Empire* (1902); *America's Economic Supremacy* (rev. ed., 1947). (M. W. CH.)

**ADAMS, CHARLES FOLLEN** (1842–1918), U.S. humorous poet, was born in Dorchester, Mass., April 21, 1842. He received a common school education. Early in the Civil War he entered the Union army and at Gettysburg was wounded and taken prisoner. In 1872 he began writing verses in German dialect, chiefly humorous, for juvenile periodicals. Collections of his verse were published under the title *Leedle Yawcob Strauss, and Other Poems* (1877) and *Dialect Ballads* (1887). His complete poetical writings under the title *Yawcob Strauss, and Other Poems,* with illustrations by "Boz," were published in 1910. He died in Boston, Mass., March 8, 1918.

**ADAMS, CHARLES FRANCIS** (1807–1886), U.S. diplomatist, son of John Quincy Adams, and grandson of John Adams, was born in Boston, Mass., Aug. 18, 1807. His father, having been appointed minister to Russia, took him in 1809 to St. Petersburg, where he acquired a perfect familiarity with French, learning it as his native tongue. After eight years spent in Russia and England, he attended the Boston Latin school for four years, and in 1825 graduated at Harvard. He lived for two years in the executive mansion, Washington, during his father's presidential term, studying law and moving in a society where he met Webster, Clay, Jackson and Randolph. Returning to Boston, he devoted ten years to business and study, and wrote for the *North American Review.* He also undertook the management of his father's pecuniary affairs, and actively supported him in his contest in the house of representatives for the right of petition and the anti-slavery cause. In 1835 he wrote an effective and widely read political pamphlet, entitled, after Edmund Burke's more famous work, *An Appeal from the New to the Old Whigs.* He was a member of the Massachusetts general court from 1840 to 1845, sitting for three years in the house of representatives and for two years in the senate; and in 1846–48 he edited a party journal, the *Boston Whig.* In 1848 he was prominent in politics as a "Conscience Whig," presiding over the Buffalo convention which formed the Free Soil party and nominated Martin Van Buren for president and himself for vice-president. He was a Republican member of the 36th congress, which assembled Dec. 5, 1859, and during the second session (Dec. 3, 1860–March 4, 1861) he represented Massachusetts in the congressional committee of 33 at the time of the secession of seven of the southern states. His selection by the chairman of this committee, Thomas Corwin, to present to the full committee certain propositions agreed upon by two-thirds of the Republican members and his calm and able speech of Jan. 31, 1861, in the house served to make him conspicuous before congress and the country. Together with William H. Seward, he stood for the Republican policy of concession; and, while he was criticized severely and charged with inconsistency in view of his record as a "Conscience Whig," he was of the same mind as President Lincoln, willing to concede nonessentials, but holding rigidly to the principle, properly understood, that there must be no extension of slavery. He believed that as the Republicans were the victors they ought to show a spirit of conciliation, and that the policy of righteousness was likewise one of expediency, since it would have for its result the holding of the border slave states with the north until March 4, when the Republicans could take possession of the government at Washington. With the incoming of the new administration Secretary Seward secured for Adams the appointment of minister to Great Britain. So much sympathy was shown in England for the south that his path was beset with difficulties; but his mission was to prevent the interference of Great Britain in the struggle; and while the work of Lincoln, Seward and Sumner, and the cause of emancipation, tended to this end, the American minister was insistent and unyielding, and knew how to present his case forcibly and with dignity. He laboured with energy and discretion to prevent the sailing of the "Alabama"; and, when unsuccessful in this, he persistently urged upon the British government its responsibility for the destruction of American merchant vessels by the privateer. In his own diary he shows that underneath his calm exterior was keen anxiety. Adams was instrumental in getting Lord John Russell to stop the "Alexandra," and to order the detention in Sept. 1863 of the two ironclad rams intended for the Confederate states. Adams remained in England until May 1868. His last important work was as a member, in 1871–72, of the tribunal at Geneva which settled the "Alabama" claims. He died at Boston, Nov. 21, 1886.

He edited the works of *John Adams* (1850–56), and the *Memoirs of John Quincy Adams* (1874–77). *See* the excellent biography (1900) by his son, Charles Francis Adams, Jr., and E. W. Adams, *Great Britain and the American Civil War* (1925).

**ADAMS, CHARLES FRANCIS** (1886– ), secretary of the navy in President Hoover's cabinet, was born in Quincy, Mass., Aug. 2, 1866, great-grandson of John Quincy Adams, 6th president, and great-great-grandson of John Adams, 2nd president of the United States; A.B., Harvard, 1888; LL.B., 1892; admitted to Suffolk bar 1893. He was a member of Quincy City council, 1893–95; mayor, 1896–97; treasurer of Harvard college, 1898–1929; amateur skipper on yacht "Resolute," which won the International Yacht Races, 1920; appointed secretary of the navy, March 5, 1929. He was a member of the American delegation at the London Naval conference, 1930.

**ADAMS, CHARLES KENDALL** (1835–1902), U.S. educator and historian, was born in Derby, Vt., on Jan. 24, 1835. He graduated in 1861 at the University of Michigan, where he was instructor of history in 1862, assistant professor of history in 1863–67 and professor of history in 1868–85. From 1885 to 1892 he was president of Cornell university, succeeding A. D. White (*q.v.*), and from 1892 to 1902 he was president of the University of Wisconsin. He edited *Representative British Orations* (1884). His published works include *Democracy and Monarchy in France* (1874) and *Christopher Columbus* (1892). He died in Redlands, Calif., on July 26, 1902.

*See* Charles Foster Smith, *Charles Kendall Adams* (1924).

**ADAMS, CLEMENT** (1519?–1587), English author. He is supposed to have been tutor to the royal pages at Greenwich. His *Anglorum Navigatio ad Moscovitas* is an account of the journey to Moscow made by Richard Chancellor and Sir Hugh Willoughby in 1553, and an English translation was printed by Richard Hakluyt in his *Principal Navigations,* vol. i (1598).

**ADAMS, EPHRAIM DOUGLASS** (1865–1930), U.S. educator and historian, brother of Henry Carter Adams (*q.v.*), was born in Decorah, Ia., Dec. 18, 1865. He graduated in 1887 from the University of Michigan from which in 1890 he received the degree of doctor of philosophy. From 1891 to 1899 he was assistant and associate professor of history and sociology, and from 1899 to 1902 professor of European history in the University of Kansas. He was associate professor of history at Stanford university from 1902 to 1906, when he was made professor.

His published writings include *Control of the Purse in the United States Government* (1894), *The Influence of Grenville on Pitt's Foreign Policy* (1904), *British Interests and Activities in Texas* (1910), *The Power of Ideals in United States History* (1913), *Great Britain, America and Democracy* (1919), *Great Britain and the American Civil War* (1925).

**ADAMS, FRANK DAWSON** (1859–1942), Canadian geologist, was born at Montreal, Que., Sept. 17, 1859. He graduated with first rank honours from McGill university, Montreal, in 1878 and took postgraduate work at McGill, Yale and Johns Hopkins university, Baltimore, Md. He received his Ph.D. from Heidelberg in 1892. Adams was appointed lecturer in geology at McGill in 1889 and in 1893 was promoted to the Logan chair of geology. He became dean of engineering in 1908 and vice-principal of the university in 1920, retiring in 1924.

Adams's contribution to pre-Cambrian geology was in determining the true nature of the foliated anorthosites, and in his description of the Grenville and its separation from the pre-Cambrian complex. He investigated the behaviour of rocks under great variations in temperature and pressure, and shed much light on the manner in which internal changes in the structure of the earth were brought about. He died Dec. 29, 1942. (J. J. O'N.)

**ADAMS, GEORGE BURTON** (1851–1925), U.S. educator and historian, was born in Fairfield, Vt., June 3, 1851.

He graduated from Beloit college, Beloit, Wis, in 1873, and received the degree of doctor of philosophy from the University of Leipzig, Germany, in 1886. He was professor of history in Drury college, Springfield, Mo., from 1877 to 1888, when he became professor of history at Yale. From 1895 to 1913 he was editor of the *American Historical Review*. He edited Duruy's *Middle Ages*, Bémont and Monod's *Mediaeval Europe*, and *Select Documents of English Constitutional History*. He died in New Haven, Conn., May 26, 1925.

His published works include *Civilization During the Middle Ages* (1894), *The Growth of the French Nation* (1896), *European History* (1899), *The Origin of the English Constitution* (1912), *Outline Sketch of English Constitutional History* (1918), *The British Empire* (1919) and *The Constitutional History of England* (1921).

ADAMS, HANNAH (1755–1831), American writer, was born in Medfield, Mass., in 1755. She is said to be the first woman in America to have made literature a profession. By private study, which she began at an early age, she acquired much varied learning, including some acquaintance with Latin and Greek. Through family reverses she was compelled from her 17th year to provide for herself. Her writings, though they brought reputation and friends, yielded but little pecuniary profit. Among her chief works were *Views of Religious Opinions* (1784), *History of New England* (1799), *Evidences of Christianity* (1801) and *History of the Jews* (1812). Her *Autobiography*, with additions by Hannah F. Adams, was published in 1832. She died in Brookline, Mass., Nov. 15, 1831.

**ADAMS, HENRY** (1838–1918), American historian, son of Charles Francis Adams and grandson of John Quincy Adams, was born in Boston, Mass, on Feb. 16, 1838. He graduated at Harvard in 1858, studied abroad, and was private secretary to his father when the latter was a congressman and minister to England. Thereafter for a brief time he did political writing in Washington; and from 1870 to 1877 he was assistant professor of history at Harvard, for most of the period also acting as editor of the *North American Review*. He is considered to have been the first to conduct historical seminary work in the United States. His *History of the United States from 1801 to 1817* (9 vols. 1889–91, new ed. 1909) took its place as the best work on the administrations of Presidents Jefferson and Madison, being specially notable for its account of the diplomatic relations of the United States during this period, and for its essential impartiality. This, like his other historical and biographical works such as the *Life of Albert Gallatin* (1879), *John Randolph* (1882), *Historical Essays* (1891), and *Chapters of Erie and Other Essays* (1871, with Charles Francis Adams, Jr.), won him a reputation among scholars. His *Mont Saint-Michel and Chartres* (1913, privately printed 1904) and *The Education of Henry Adams* (1918, privately printed 1906) revealed him to a much wider audience as a writer of delicate sensibilities and refined taste. *Mont Saint Michel and Chartres* is one of the most valuable studies of mediaevalism yet produced in America, not only for the aid which it affords in the appreciation of the literary and architectural monuments of the past, but for the conception which it gives of the animating forces which produced these monuments. The autobiography which attempted to show how ill-adapted eighteenth-century man and education were for the needs of the twentieth century was one of the most widely discussed books of its decade in America. Correlating with these books to a certain extent was Adams's *Letter to American Teachers of History* (1910). He died in Washington on March 27, 1918. Posthumous publications were *The Degradation of the Democratic Dogma* (1919, with an introduction by Brooks Adams) and *Letters to a Niece and Prayer to the Virgin of Chartres* by Henry Adams, with *A Niece's Memories* by Mabel La Farge (1920). After his death he was named by Henry Holt as the author of *Democracy*, an anonymous novel of 1880.

His elder brother, JOHN QUINCY ADAMS (1833–1894), a graduate of Harvard (1853), practised law, and was for several terms a Democratic member of the Massachusetts general court. In 1872 he was nominated for vice president by the Democratic faction that refused to support Horace Greeley.

Another brother, CHARLES FRANCIS ADAMS, JR. (1835–1915), born in Boston, on May 27, 1835, graduated at Harvard in 1856, and was admitted to the bar in 1858. During the Civil War he served on the Union side, receiving, in 1865, the brevet of brigadier general. He was president of the Union Pacific railroad from 1884–90, having previously become widely known as an authority on the management of railways In 1900–01 he was president of the American Historical Association He died in Washington, D C., on March 20, 1915. His autobiography was published in 1916 with a memorial address by Henry Cabot Lodge.

Among his writings are: *Railroads, Their Origin and Problems* (rev. ed. 1887); *Three Episodes of Massachusetts History* (1892); a biography of his father, *Charles Francis Adams* (1900); *Lee at Appomattox and Other Papers* (1902); *Three Phi Beta Kappa Addresses* (1907); *Studies Military and Diplomatic 1775–1865* (1911); and *Atlantic Historical Solidarity* (1913), lectures delivered at Oxford.

Another brother, BROOKS ADAMS (1848–1927), was born in Quincy, Mass., on June 24, 1848, graduated at Harvard in 1870, and until 1881 practised law. He died in Boston, Feb. 13, 1927.

His writings include: *The Emancipation of Massachusetts: The Dream and the Reality* (rev. ed. 1920); *The Law of Civilization and Decay* (1895); *America's Economic Supremacy* (1900); and *The New Empire* (1902).

**ADAMS, HENRY CARTER** (1852–1921), American economist, was born at Davenport, Ia., Dec. 31, 1852. He was educated at Iowa college and Johns Hopkins university, where he was a fellow 1876–78, and in French and German universities. He afterwards taught at Cornell university, and in 1887 became professor of political economy and finance in the University of Michigan. He also became statistician to the Interstate Commerce Committee and was in charge of the transport department in the 1900 census. His principal works include *The State in Relation to Industrial Action* (1887); *Public Debts* (1887); *The Science of Finance* (1888); *Economics and Jurisprudence* (1897); *Description of Industry* (1918) and *American Railway Accounting* (1918). He died Aug. 11, 1921.

**ADAMS, HERBERT** (1858–1945), American sculptor, was born at West Concord (Vt.) on Jan. 28, 1858. He was educated at the Worcester Institute of Technology and at the Massachusetts normal art school, and in 1885–90 he was a pupil of Antonin Mercié in Paris. In 1890–98 he was an instructor in the art school of Pratt institute, Brooklyn, New York. In 1906 he was elected vice-president of the National Academy of Design, New York, and from 1917–20 served as president. He experimented successfully with some polychrome busts and tinted marbles, notably in the "Rabbi's Daughter" and a portrait of Julia Marlowe, the actress. He was at his best in his portrait busts of women, the finest example being the study, completed in 1887, of Miss A. V. Pond, whom he afterwards married. Among his other productions are a fountain for Fitchburg (Mass, 1888); a number of works for the Congressional library, Washington, including the bronze doors ("Writing") begun by Olin Warner, and the statue of Prof. Joseph Henry; memorial tablets for the Boston State House; a memorial of Jonathan Edwards at Northampton (Mass.); statues of Richard Smith, the type-founder, in Philadelphia, and of William Ellery Channing, in Boston (1902); the Vanderbilt memorial bronze doors for St. Bartholomew's church, New York; the group of figures for McMillan fountain in McMillan park, Washington (D.C.); reliefs for tomb of Ellen Axson Wilson (Mrs. Woodrow Wilson). He died May 21, 1945.




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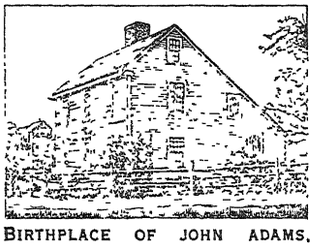
ADAMS'S POLYCHROME BUST "PRIMAVERA" SHOWS A LEANING TOWARD THE ITALIAN "QUATTROCENTO" AND THE WORK OF THE DELLA ROBBIAS

**ADAMS, HERBERT BAXTER** (1850–1901), American historian and educationalist, was born at Shutesbury (Mass.) on April 16, 1850. He graduated at Amherst, at the head of his class,

in 1872; and after studying at Göttingen and Berlin he received the degree of Ph D. at Heidelberg in 1876, with the highest honours Thereafter almost until his death he was connected with the Johns Hopkins university, Baltimore (Md.), becoming professor of American and institutional history in 1891. He was one of the founders of the American Historical Association, of which he was secretary until 1900. In 1882 he founded the "Johns Hopkins University Studies in Historical and Political Science," of which he became editor. It was as a teacher, however, that Adams rendered his most valuable services, and many American historical scholars owe their training, and to a considerable extent their enthusiasm, to him. He died at Amherst (Mass ) on July 30, 1901. Among his writings are: *Maryland's Influence in Founding a National Commonwealth* (1877); *Methods of Historical Study* (1884); *Maryland's Influence upon Land Cessions to the United States* (1885); and the *Life and Writings of Jared Sparks* (1893).

See *Herbert B. Adams: Tributes of Friends* (1902); extra vol. (xxiii ) of "Studies in Historical and Political Science."

**ADAMS, JOHN** (1735–1826), second president of the United States of America, was born Oct. 30, 1735, in what is now the town of Quincy (Mass ). His father, a farmer, also named John, was of the fourth generation in descent from Henry Adams, who emigrated from Devonshire, England, to Massachusetts about 1636; his mother was Susanna Boylston Adams. Young Adams graduated from Harvard college in 1755, and for a time taught in school at Worcester and studied law in the office of Rufus Putnam. In 1758 he was admitted to the bar. From an early age he developed the habit of writing descriptions of events and impressions of men. The earliest of these is his report of the argument of James Otis in the superior court of Massachusetts as to the constitutionality of writs of assistance. This was in 1761, and the argument inspired him with zeal for the cause of the American colonies. Years afterwards, when an old man, Adams undertook to write out at length his recollections of this scene; it is instructive to compare the two accounts. John Adams had none of the qualities of popular leadership which were so marked a characteristic of his second cousin, Samuel Adams; it was rather as a constitutional lawyer that he influenced the course of events. He was impetuous, intense and often vehement, unflinchingly courageous, devoted with his whole soul to the cause he had espoused; but his vanity, his pride of opinion and his inborn contentiousness were serious handicaps to him in his political career. These qualities were particularly manifested at a later period—as, for example, during his term as president. He first made his influence widely felt and became conspicuous as a leader of the Massachusetts Whigs during the discussions with regard to the Stamp Act of 1765. In that year he drafted the instructions which were sent by the town of Braintree to its representatives in the Massachusetts legislature, and which served as a model for other towns in drawing up instructions to their representatives; in Aug. 1765 he contributed anonymously four notable articles to the *Boston Gazette* (republished separately in London in 1768 as *A Dissertation on the Canon and Feudal Law*), in which he argued that the opposition of the colonies to the Stamp Act was a part of the never-ending struggle between individualism and corporate authority; and in Dec. 1765 he delivered a speech before the governor and council in which he pronounced the Stamp Act invalid on the ground that Massachusetts, being without representation in parliament, had not assented to it. In 1768 he removed to Boston. Two years later, with that degree of moral courage which was one of his distinguishing characteristics, as it has been of his descendants, he, aided by Josiah Quincy, Jr., defended the British soldiers who were arrested after the "Boston Massacre," charged with causing the death of four persons, inhabitants of the colony. The trial resulted in an acquittal of the officer who commanded the detachment, and most of the soldiers; but two soldiers were found guilty of manslaughter. These claimed benefit of clergy and were branded in the hand and released. Adams's upright and patriotic conduct in taking the unpopular side in this case met with its just reward in the following year, in the shape of his election to the Massachusetts House of Representatives by a vote of 418 to 118.



BIRTHPLACE OF JOHN ADAMS, SECOND PRESIDENT OF THE UNITED STATES OF AMERICA, AT QUINCY, MASS.

John Adams was a member of the Continental Congress from 1774 to 1778. In June 1775, with a view to promoting the union of the colonies, he seconded the nomination of Washington as commander-in-chief of the army. His influence in congress was great, and almost from the beginning he was impatient for a separation of the colonies from Great Britain On June 7, 1776, he seconded the famous resolution introduced by Richard Henry Lee (*q.v.*) that "these colonies are, and of a right ought to be, free and independent states," and no man championed these resolutions (adopted on July 2) so eloquently and effectively before the congress. On June 8 he was appointed on a committee with Jefferson, Franklin, Livingston and Sherman to draft a Declaration of Independence; and although that document was by the request of the committee written by Thomas Jefferson, it was John Adams who occupied the foremost place in the debate on its adoption Before this question had been disposed of, Adams was placed at the head of the board of war and ordnance, and he also served on many other important committees.

In 1778 John Adams sailed for France to supersede Silas Deane in the American commission there. But just as he embarked that commission concluded the desired treaty of alliance, and soon after his arrival he advised that the number of commissioners be reduced to one. His advice was followed and he returned home in time to be elected a member of the convention which framed the Massachusetts constitution of 1780, still the organic law of that commonwealth. With James Bowdoin and Samuel Adams, he formed a sub-committee which drew up the first draft of that instrument, and most of it probably came from John Adams's pen.

Before this work had been completed he was again sent to Europe, having been chosen, Sept. 27, 1779, as minister plenipotentiary for negotiating a treaty of peace and a treaty of commerce with Great Britain. Conditions were not then favourable for peace, however; the French Government, moreover, did not approve of the choice, inasmuch as Adams was not sufficiently pliant and tractable and was from the first suspicious of Vergennes; and subsequently Benjamin Franklin, Thomas Jefferson, John Jay and Henry Laurens were appointed to co-operate with Adams. Jefferson, however, did not cross the Atlantic, and Laurens took little part in the negotiations. This left the management of the business to the other three. Jay and Adams distrusted the good faith of the French Government. Outvoting Franklin, they decided to break their instructions, which required them to "make the most candid confidential communications on all subjects to the ministers of our generous ally, the king of France; to undertake nothing in the negotiations for peace or truce without their knowledge or concurrence; and ultimately to govern yourself by their advice and opinion"; and, instead, they dealt directly with the British commissioners, without consulting the French ministers. Throughout the negotiations Adams was especially determined that the right of the United States to the fisheries along the British-American coast should be recognized. Political conditions in Great Britain, at the moment made the conclusion of peace almost a necessity with the British ministry, and eventually the American negotiators were able to secure a peculiarly favourable treaty. This preliminary treaty was signed Nov. 30, 1782. Before these negotiations began, Adams had spent some time in the Netherlands. In July 1780 he had been authorized to execute the duties previously assigned to Henry Laurens, and at The Hague was eminently successful, securing there recognition of the United States as an independent government (April 19, 1782), and negotiating both a loan and, in Oct. 1782, a treaty of amity and commerce, the first of such

treaties between the United States and foreign powers after that of Feb. 1778 with France

In 1785 John Adams was appointed the first of a long line of able and distinguished American ministers to the court of St. James's. When he was presented to his former sovereign, George III. intimated that he was aware of Adams's lack of confidence in the French Government. Replying, Adams admitted it, closing with the outspoken sentiment: "I must avow to your Majesty that I have no attachment but to my own country"—a phrase which must have jarred upon the monarch's sensibilities. While in London Adams published a work entitled *A Defence of the Constitutions of Government of the United States* (1787). In this work he ably combated the views of Turgot and other European writers as to the viciousness of the framework of the state governments Unfortunately, in so doing, he used phrases savouring of aristocracy which offended many of his countrymen—as in the sentence in which he suggested that "the rich, the well-born and the able" should be set apart from other men in a senate. Partly for this reason, while Washington had the vote of every elector in the first presidential election of 1789, Adams received only 34 out of 69 As this was the second largest number he was declared vice-president, but he began his eight years in that office (1789–97) with a sense of grievance and of suspicion of many of the leading men. Differences of opinion with regard to the policies to be pursued by the new government gradually led to the formation of two well-defined political groups—the Federalists and the Democratic-Republicans—and Adams became recognized as one of the leaders, second only to Alexander Hamilton, of the Federalists.

In 1796, on the refusal of Washington to accept another election, Adams was chosen president, defeating Thomas Jefferson; though Alexander Hamilton and other Federalists had asked that an equal vote should be cast for Adams and Thomas Pinckney, the other Federalist in the contest, partly in order that Jefferson, who was elected vice president, might be excluded altogether, and partly, it seems, in the hope that Pinckney should in fact receive more votes than Adams, and thus, in accordance with the system then obtaining, be elected president, though he was intended for the second place on the Federalist ticket. Adams's four years as chief magistrate (1797–1801) were marked by a succession of intrigues which embittered all his later life; they were marked, also, by events such as the passage of the Alien and Sedition acts, which brought discredit on the Federalist party. Moreover, factional strife broke out within the party itself; Adams and Hamilton became alienated, and members of Adams's own cabinet virtually looked to Hamilton rather than to the president as their political chief. The United States was, at this time, drawn into the vortex of European complications, and Adams, instead of taking advantage of the militant spirit which was aroused, patriotically devoted himself to securing peace with France, much against the wishes of Hamilton and of Hamilton's adherents in the cabinet. In 1800, Adams was again the Federalist candidate for the presidency, but the distrust of him in his own party, the popular disapproval of the Alien and Sedition acts and the popularity of his opponent, Thomas Jefferson, combined to cause his defeat. He then retired into private life. On July 4, 1826, on the 50th anniversary of the adoption of the Declaration of Independence, he died at Quincy. Jefferson died on the same day. In 1764 Adams had married Abigail Smith (1744–1818), the daughter of a Congregational minister at Weymouth (Mass.). She was a woman of much ability, and her letters, written in an excellent English style, are of great value to students of the period in which she lived. President John Quincy Adams was their eldest son.

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**ADAMS, JOHN COUCH** (1819–1892), British astronomer, was born at Lidcot farmhouse, Laneast, Cornwall, on June 5, 1819 He was educated at St. John's College, Cambridge, and was senior wrangler and first Smith's prizeman of his year, 1843. While still an undergraduate he read of certain unexplained irregularities in the motion of the planet Uranus and determined to investigate them, with a view to ascertaining whether they might not be due to the action of a remote undiscovered planet. Elected fellow of his college in 1843, he at once attacked the problem. It was this: from the observed perturbations of a known planet to deduce by calculation, assuming only Newton's law of gravitation, the mass and orbit of an unknown disturbing body. By Sept 1845 he obtained his first solution, and handed to Prof. Challis, the director of the Cambridge Observatory, a paper giving the elements of what he described as "the new planet"

It was not until July 1846 that the search for the new planet was begun at Cambridge. Meanwhile the French astronomer Leverrier had been working along similar lines with equally successful results, and a controversy arose as to whether the discovery of the new planet, Neptune, should be ascribed to the English or the French astronomer. As the facts became known the world recognized that the two astronomers had independently solved the problem of Uranus The new planet, at first called *Leverrier* by F. Arago, received by general consent the neutral name of *Neptune* Its mathematical prediction was an unsurpassed intellectual feat.

In 1851 Adams became president of the Royal Astronomical Society. His lay fellowship at St. John's College came to an end in 1852, but Pembroke College elected him in the following year to a lay fellowship which he held for the rest of his life. In 1858 he became professor of mathematics at St. Andrews, but lectured only for a session, when he vacated the chair for the Lowndean professorship of astronomy and geometry at Cambridge. Two years later he succeeded Challis as director of the Observatory, where he resided until his death.

Although Adams's researches on Neptune were those which attracted widest notice, his subsequent work on gravitational astronomy and terrestrial magnetism was not less remarkable. In 1852 he published new and accurate tables of the moon's parallax, which superseded J. K. Burckhardt's, and supplied corrections to the theories of M. C. T. Damoiseau, G. A. A. Plana and P. G. D. de Pontécoulant. In the following year his memoir on the secular acceleration of the moon's mean motion partially invalidated Laplace's famous explanation, which had held its place unchallenged for 60 years. For these researches the Royal Astronomical Society awarded him its gold medal in 1866. The great meteor shower of 1866 turned his attention to the Leonids, whose probable path and period had already been discussed by Prof. H. A. Newton. Adams ascertained that this cluster of meteors, which belongs to the solar system, traverses an elongated ellipse in 33 years and three months, and is subject to definite perturbations from the larger planets, Jupiter, Saturn and Uranus. These results were published in 1867. Ten years later, when G. W. Hill of Washington expounded a new method for dealing with the problem of the lunar motions, Adams briefly announced his own unpublished work in the same field, which, following a parallel course, had confirmed and supplemented Hill's.

The determination of the constants in Gauss's theory of terrestrial magnetism occupied him at intervals for more than 40 years. The calculations involved great labour, and were not published during his lifetime. They were edited by his brother, Prof. W. Grylls Adams, and appear in the second volume of the collected *Scientific Papers.* Numerical computations of this kind might almost be described as his pastime. The value of the constant known as Euler's, and the Bernoullian numbers up to the 62nd, he worked out to an incredible degree of accuracy. For Newton and his writings he had a boundless admiration; many of his papers, indeed, bear the cast of Newton's thought. He laboured for many years at the task of arranging and cataloguing the great collection of Newton's unpublished mathematical writings, presented in 1872 to the University by Lord Portsmouth, and wrote the account of them issued in a volume by the University Press in 1888.

The post of astronomer-royal was offered him in 1881, but he

preferred to pursue his peaceful course of teaching and research in Cambridge. After a long illness he died at the Cambridge Observatory on Jan. 21, 1892, and was buried in St. Giles's cemetery, near his home.

BIBLIOGRAPHY.—*The Scientific Papers of John Couch Adams*, 4to vol. i. (1896), and vol. ii. (1900), edited by William Grylls Adams and Ralph Allen Sampson with a memoir by Dr. J. W. L. Glaisher, were published by the Cambridge University Press. The first volume contains his previously published writings; the second those left in manuscript, including the substance of his lectures on the Lunar Theory. A collection, virtually complete, of Adams's papers regarding the discovery of Neptune was presented by Mrs. Adams to the library of St. John's College. A description of them by Prof. Sampson was inserted in the *Memoirs* of the Royal Astronomical Society, liv. p. 143).

**ADAMS, JOHN QUINCY** (1767–1848), eldest son of President John Adams, sixth president of the United States, was born on July 11, 1767, in that part of Braintree that is now Quincy (Mass.), and was named after John Quincy (1689–1767), his mother's grandfather, who was for many years a prominent member of the Massachusetts legislature. In 1778 and again in 1780, young Adams accompanied his father to Europe; studying in Paris in 1778–79 and at the University of Leyden in 1780. In 1780, also, he began to keep that diary which forms so conspicuous a record of the doings of himself and his contemporaries. In 1781, at the age of 14, he accompanied Francis Dana (1743–1811), American envoy to Russia, as his private secretary; but Dana was not received by the Russian Government, and in 1782 Adams joined his father at Paris, where he acted as "additional secretary" to the American commissioners in the negotiation of the treaty of peace which concluded the War of Independence Instead of accompanying his father to London, he, of his own choice, returned to Massachusetts, graduated at Harvard college in 1787, three years later was admitted to practice at the bar and at once opened an office in Boston. A series of papers written by him in which he controverted some of Thomas Paine's doctrines in the *Rights of Man*, and later another series in which he ably supported the neutral policy of the Administration toward France and England, led to his appointment by Washington as minister to the Netherlands in May 1794. There was little for him to do at The Hague, but in the absence of a minister at London, he transacted certain public business with the English foreign secretary. In 1796 Washington appointed him minister to Portugal, but before his departure thither his father John Adams became president and changed his destination to Berlin (1797). While there, he negotiated (1799) a treaty of amity and commerce with Prussia. On Thomas Jefferson's election to the presidency in 1800, the elder Adams recalled his son, who returned home in 1801. The next year, he was elected to the Massachusetts senate, and in 1803 was sent to Washington as a member of the Senate of the United States.

Up to this time, John Quincy Adams was regarded as belonging to the Federalist Party, but he now found its general policy displeasing to him, was frowned upon, as the son of his father, by the followers of Alexander Hamilton, and found himself practically powerless as an unpopular member of an unpopular minority. He was not, and indeed never was, a strict party man. On the first important question that came before him in the Senate, the acquisition of Louisiana, he voted with the Republicans, regardless of the opposition of his own section. In Dec. 1807 he warmly seconded Jefferson's suggestion of an embargo and vigorously urged instant action, saying: "The president has recommended the measure on his high responsibility. I would not consider, I would not deliberate; I would act!" Within five hours the Senate had passed the Embargo bill and sent it to the House. The support of a measure so unpopular in New England caused him to be hated by the Federalists there, and cost him his seat in the Senate; his successor was chosen on June 3, 1808, several months before the usual time of filling the vacancy, and five days later Adams resigned. In the same year he attended the Republican congressional caucus which nominated Madison for the presidency, and thus definitely joined the Republicans. From 1806 to 1809 Adams was professor of rhetoric and oratory at Harvard.

In 1809 President Madison sent Adams to Russia to represent the United States. He arrived at St. Petersburg (Leningrad) at the psychological moment when the tsar had made up his mind to break with Napoleon. Adams therefore met with a favourable reception and a disposition to further the interests of American commerce in every possible way. On the outbreak of the war between the United States and England in 1812, he was still at St Petersburg. In September of that year, the Russian Government suggested that the tsar was willing to act as mediator between the two belligerents. Madison precipitately accepted this proposition and sent Albert Gallatin and James Bayard to act as commissioners with Adams; but England would have nothing to do with it. In Aug. 1814, however, these gentlemen, with Henry Clay and Jonathan Russell, began negotiations with English commissioners which resulted in the signature of the Treaty of Ghent on Dec 24 of that year. After this Adams visited Paris, where he witnessed the return of Napoleon from Elba, and then went to London, where, with Henry Clay and Albert Gallatin, he negotiated (1815) a "Convention to Regulate Commerce and Navigation." Soon afterwards he became U S. minister to Great Britain, as his father had been before him, and as his son, Charles Francis Adams, was after him. After accomplishing little in London, he returned to the United States in the summer of 1817 to become secretary of State in the cabinet of President Monroe.

**Later Career.**—As secretary of State, Adams played the leading part in the acquisition of Florida and the promulgation of the Monroe Doctrine. Ever since the acquisition of Louisiana successive administrations had sought to include a part at least of Florida in that purchase. In 1819, after long negotiations, Adams succeeded in bringing the Spanish minister to the point of signing a treaty in which the Spaniards abandoned all claims to territory east of the Mississippi, and the United States relinquished all claim to what is now known as Texas. Before the Spanish Government ratified the treaty in 1820, Mexico, including Texas, had thrown off allegiance to the mother country, and the United States had occupied Florida by force of arms. The Monroe Doctrine (*q.v.*) rightly bears the name of the president who in 1823 assumed the responsibility for its promulgation; but it was primarily the work of John Quincy Adams. The eight years of Monroe's presidency (1817–25) are known as the "Era of Good Feeling." As his second term drew to a close, there was a great lack of good feeling among his official advisers, three of whom—Adams, secretary of State, Calhoun, secretary of War, and Crawford, secretary of the Treasury—aspired to succeed him in his high office. In addition Henry Clay and Andrew Jackson were also candidates. Calhoun was nominated for the vice-presidency. Of the other four, Jackson received 99 electoral votes, Adams 84, Crawford 41, and Clay 37; as no one had a majority, the decision was made by the House of Representatives, which was confined in its choice to the three candidates who had received the largest number of votes. Clay, who was speaker of the House of Representatives, and had for years assumed a censorious attitude toward Jackson, cast his influence for Adams and thereby secured his election on the first ballot. A few days later Adams offered Clay the secretaryship of State, which was accepted. The wholly unjust and baseless charge of "bargain and corruption" followed, and the feud thus created between Adams and Jackson greatly influenced the history of the United States.

Up to this point Adams's career had been almost uniformly successful, but his presidency (1825–29) was in most respects a failure, owing to the virulent opposition of the Jacksonians; in 1828 Jackson was elected president over Adams. It was during his administration that irreconcilable differences developed between the followers of Adams and the followers of Jackson, the former becoming known as the National Republicans, who with the Anti-Masons were the precursors of the Whigs. In 1829 Adams retired to private life in the town of Quincy; but only for a brief period, for in 1830, largely by Anti-Masonic votes, he was elected a member of the national House of Representatives. On its being suggested to him that his acceptance of this position would degrade an ex-president, Adams replied that no person could be degraded by serving the people as a representative in Congress or, he added, as a selectman of his town. His service in Congress from 1831

until his death is, in some respects, the most noteworthy part of his career.

Throughout he was conspicuous as an opponent of the extension of slavery, though he was never technically an abolitionist, and in particular he was the champion in the House of Representatives of the right of petition at a time when, through the influence of the Southern members, this right was, in practice, denied by that body. His prolonged fight for the repeal of the so-called "gag laws" is one of the most dramatic contests in the history of Congress. The agitation for the abolition of slavery, which really began in earnest with the establishment of the *Liberator* by William Lloyd Garrison in 1831, soon led to the sending of innumerable petitions to Congress for the abolition of slavery in the District of Columbia, over which the Federal Government had jurisdiction, and for other action by Congress with respect to that institution. These petitions were generally sent to Adams for presentation. They aroused the anger of the pro-slavery members of Congress, who, in 1836, brought about the passage of the first "gag rule," the Pinckney resolution, presented by Henry L. Pinckney, of South Carolina. It provided that all petitions relating to slavery should be laid on the table without being referred to committee or printed; and, in substance, this resolution was readopted at the beginning of each of the immediately succeeding sessions of Congress, the Patton resolution being adopted in 1837, the Atherton resolution, or "Atherton gag," in 1838, and the Twenty-first rule in 1840 and subsequently until repealed. Adams contended that these "gag rules" were a direct violation of the First amendment to the Federal Constitution, and refused to be silenced on the question, fighting for repeal with indomitable courage, in spite of the bitter denunciation of his opponents. Each year the number of anti-slavery petitions received and presented by him increased; perhaps the climax was in 1837, when Adams presented a petition from 22 slaves, and, when threatened by his opponents with censure, defended himself with remarkable keenness and ability. At each session, also, the majority against him decreased until in 1844 his motion to repeal the Twenty-first rule was carried by a vote of 108 to 80 and his battle was won. On Feb. 21, 1848, after having suffered a previous stroke of apoplexy, he fell insensible on the floor of the Representatives' chamber, and two days later died. Few men in American public life have possessed more intrinsic worth, more independence, more public spirit and more ability than Adams; but throughout his political career he was handicapped by a certain reserve, a certain austerity and coolness of manner, and by his consequent inability to appeal to the imaginations and affections of the people as a whole. He had few intimate friends, and few men in American history have, during their lifetime, been regarded with so much hostility and attacked with so much rancour by their political opponents. Adams was married in 1797 to Louisa Catherine Johnson (1775–1852).

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**ADAMS, MAUDE** (1872– ), American actress, was born in Salt Lake City, Utah, on Nov. 11, 1872. The family name was Kiskadden, but she adopted the maiden name, Adams, of her mother, an actress. From an early age she played juvenile parts, and at the age of 16 went to New York. From her appearance in Hoyt's *A Midnight Bell,* in 1889, her popularity grew steadily. In 1897 Charles Frohman gave her her first leading part as Lady Babbie in *The Little Minister;* and in *Peter Pan* she achieved a great success. She introduced Rostand to the American stage, taking the title-rôle in *L'Aiglon* in 1901, and in *Chantecler* in 1911. Other plays in her repertory were *Romeo and Juliet, The Pretty Sister of José, The Jester* and *As You Like It.*

**ADAMS, OSCAR FAY** (1855–1919), American author and editor, was born in Worcester, Mass., in 1855. He was educated in the New Jersey State Normal school. He became a teacher of English literature and a frequent contributor to periodicals. In 1886 he edited *Through the Year with the Poets,* in 12 volumes. His published writings include *The Story of Jane Austen's Life* (1891, 2nd ed. 1897); *The Archbishop's Unguarded Moment and Other Stories* (1899); *A Brief Handbook of English Authors* (1884, 7th ed. 1893); *Dear Old Story Tellers* (1889, new ed. 1911); *A Dictionary of American Authors* (1897, 5th ed. 1905); and *A Motley Jest—Shakespearean Diversions* (1909). He was also American editor for *The Henry Irving Shakespeare.* He died in North Truro, Mass., April 30, 1919.

**ADAMS, ROBERT** (1791–1875), Irish clinician noted for his accounts of essential heart block and rheumatic gout. His name is associated with that of his colleague, William Stokes, in the Stokes-Adams syndrome, a condition of the heart characterized by slowed pulse and giddiness.

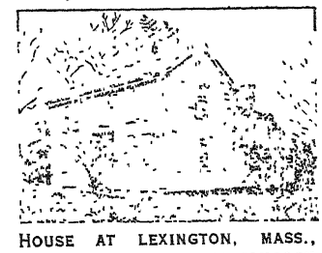
See *Biographisches Lexicon,* vol. 1 (1929). (F. L. A.)

**ADAMS, ROGER** (1889– ), U.S. chemist, was born in Boston, Mass., on Jan. 2, 1889. He was educated at Harvard university, from which he graduated in 1909 and received the degree of Ph.D. in 1912. Following two years' study at the University of Berlin and the Kaiser Wilhelm institute, 1912–13, he returned to Harvard, where he was instructor in organic chemistry for three years. In 1916 he was made assistant professor, in 1919 professor and in 1926 head of the department of organic chemistry, in the University of Illinois. He made important researches on catalysts, local anaesthetics, platinum oxide, alkali-insoluble phenols, chaulmoogric acid derivatives and other organic compounds, receiving numerous awards including the Joseph Priestley medal (1946).

His writings include *Organic Syntheses* (1921) and many articles on chemical subjects.

**ADAMS, SAMUEL** (1722–1803), U.S. statesman, born in Boston, Mass., on Sept. 27, 1722, a second cousin to the elder John Adams. He graduated from Harvard college in 1740 and began the study of law. Though he repeatedly failed in business and was sued because of his easy methods as tax collector, he became so influential in local politics as to be called the "Man of the Town Meeting."

He first came into wider prominence at the beginning of the Stamp act episode, when as author of Boston's instructions to its representatives in the general court of Massachusetts he urged strenuous opposition to taxation by act of parliament. At about the same time he was elected to the lower house of the general court, in which he served until 1774, after 1766 as clerk. As James Otis's vigour and influence declined, Adams took a more prominent position in the revolutionary councils, in which he advised against any form of compromise. Many of the Massachusetts revolutionary documents, including the famous "Massachusetts Resolves" and the circular letter to the legislatures of the other colonies, are from his pen. Indeed, there can be no question that he was one of the first American political leaders to deny the legislative power of parliament and to desire and advocate separation from the mother country.



HOUSE AT LEXINGTON, MASS., FROM WHICH ADAMS AND HANCOCK ESCAPED WHEN AROUSED BY PAUL REVERE

To promote the ends he had in view Adams suggested non-importation instituted the Boston committees of correspondence, [illegible] a Continental Congress be called, and wrote a vast number of articles for the newspapers, especially the Boston *Gazette,* over a multitude of signatures. He was, in fact, one of the most voluminous and influential political writers of his time. His style is clear, vigorous and epigrammatic; his arguments are characterized by strength of logic and appeals to passion, and are based not so much on precedent and documentary authority as on "natural right."

Although he lacked oratorical fluency, his short speeches, like his writings, were forceful; and he was an eminently successful manager of men, shrewd, wily, adroit, an adept in all the arts of the politician. He is considered to have done more than any other

one man, in the years immediately preceding the War of Independence, to mould and direct public opinion in his community; and by his contemporaries he was credited with equally successful management of the delegates to the first Continental Congress.

During the intense excitement which followed the "Boston Massacre," Adams skilfully secured the removal of the soldiers from the town to a fort in the harbour. He also managed the proceedings of the "Boston Tea Party," and later he was leader in the opposition to the Boston Port bill. One of the objects of the expedition sent by the governor, Gen. Thomas Gage, to Lexington, Mass., (*q.v.*) and Concord, N.H., on April 18–19, 1775, was the capture of Adams and John Hancock, temporarily staying in Lexington, and when Gage issued his proclamation of pardon on June 12 he excepted these two, whose offenses, he said, were "of too flagitious a nature to admit of any other consideration than that of condign punishment."

As a delegate to the Continental Congress, from 1774 to 1781, Adams vigorously opposed any concession to the British government, strove for harmony among the several colonies in the common cause, served on the committee to prepare a plan of confederation and signed the Declaration of Independence. His most important service was in organizing the forces of revolution before 1775.

In 1779 he was a member of the convention which framed the constitution of Massachusetts adopted in 1780, and in 1788 a member of the Massachusetts convention to ratify the constitution of the United States. From 1789 to 1794 Adams was lieutenant governor of his state, and from 1794 to 1797 governor. After the formation of parties he became allied with the Democratic-Republicans rather than with the Federalists. He died in Boston on Oct. 2, 1803.

BIBLIOGRAPHY.—W. V. Wells, *Life and Public Services of Samuel Adams,* 3 vols (1865), a valuable biography, containing a mass of information, but noticeably biased; J. K. Hosmer *Samuel Adams* (1885), a good short biography; R. V. Harlow, *Samuel Adams, Promoter of the American Revolution* (1923), an attempt to explain Adams' activity psychologically; Philip Guedalla, *Fathers of the Revolution* (1926, Eng. ed., *Independence Day*). *See* also M. C. Tyler, *Literary History of the American Revolution,* 2 vols. (1897); H. A. Cushing (ed.), *The Writings of Samuel Adams,* 4 vols (1904–08); and "Warren-Adams Letters," 2 vols., Mass. Hist. Soc., *Collections* (1917–25). (E. C.)

**ADAMS, SAMUEL HOPKINS** (1871– ), U.S. author, was born in Dunkirk, N.Y., on Jan. 26, 1871. He graduated from Hamilton college, Clinton, N.Y., in 1891 and entered journalism. From 1891 to 1900 he was engaged as a reporter and special writer for the *New York Sun.* He was managing editor of McClure's syndicate in 1900–01, advertising manager of McClure, Phillips and Company in 1901–02, and from 1903 to 1905 member of the editorial staff of *McClure's Magazine.*

In 1905 he contributed to *Collier's Weekly* a noteworthy series of articles exposing fraudulent quack medicines, and in 1915–16, in the *New York Tribune,* he similarly exposed dishonourable practices in advertising.

Among his published writings are: *The Mystery,* with Stewart Edward White (1905); *The Great American Fraud* (1906); *The Flying Death* (1906); *Average Jones* (1911); *The Secret of Lonesome Cove* (1913); *The Health Master* (1913); *The Clarion* (1914); *Little Miss Grouch* (1915); *The Unspeakable Perk* (1916); *Our Square and the People in It* (1917); *Common Cause* (1918), *Wanted, a Husband* (1919); *Revelry* (1926); *The Gorgeous Hussy* (1934); *Maiden Effort* (1937); and *A. Woollcott: His Life and His Works* (1946).

**ADAMS, SARAH FLOWER** (1805–1848), English poet, was born at Great Harlow, Essex, Feb. 22, 1805. She was the daughter of Benjamin Flower and in 1834 married William Bridges Adams, inventor and pamphleteer. She was a Unitarian and her writings are chiefly religious. Her longest work, *Vivia Perpetua* (1841), a dramatic poem having for its subject the life of the early Christians, contains impressive passages. Besides various other poems, she wrote several beautiful hymns, the best known of which is "Nearer, My God, to Thee" (1840). She died in Aug. 1848.

**ADAMS, WALTER SYDNEY** (1876– ), U.S. astronomer, was born in Antioch, northern Syria, on Dec. 20, 1876. He graduated from Dartmouth college, Hanover, N.H., in 1898, studied at The University of Chicago in 1899–1900 and at the University of Munich in 1901. For the ensuing three years he was an assistant and instructor in the Yerkes observatory at Lake Geneva, Wis. He was assistant astronomer at the Mt. Wilson observatory of the Carnegie institution, Pasadena, Calif., from 1904 to 1909, when he was made astronomer. He served also as acting or assistant director of the observatory from 1910 until 1923, and then as director from 1923 to 1946. His writings include a memoir on the rotation of the sun and papers on stellar motions, solar and stellar spectroscopy.

In 1935 he received the Janssen medal of the Paris Academy of Sciences.

**ADAMS, WILLIAM** (d. 1620), English navigator, the first Englishman in Japan, was born at Gillingham, near Chatham, England. When 12 years old he was apprenticed in the mercantile marine, afterward entering the British navy, and later serving the company of Barbary merchants as master and pilot. Attracted by the Dutch trade with India, he shipped as pilot major with a little fleet of five ships dispatched from the Texel in 1598 by a company of Rotterdam merchants. The vessels, boats ranging from 75 to 250 tons and crowded with men, were driven to the coast of Guinea, where the adventurers attacked the island of Annabon for supplies, and finally reached the straits of Magellan. Scattered by stress of weather the following spring, the "Charity," with Adams on board, and the "Hope" met at length off the coast of Chile, where the captains of both vessels lost their lives in an encounter with the Indians. In fear of the Spaniards, the remaining crews determined to sail across the Pacific. On this voyage the "Hope" was lost, but in April 1600 the "Charity," with a crew of sick and dying men, was brought to anchor off the island of Kiushiu, Japan.

Adams was summoned to Osaka and there examined by Iyeyasu, the guardian of the young son of Taiko Sama, the ruler, who had just died. His knowledge of ships and shipbuilding, and his nautical smattering of mathematics, raised him in the estimation of the shogun, and he was presented with an estate at Hémi near Yokosuka; but was refused permission to return to England. In 1611 news came to him of an English settlement in Bantam, and he wrote asking for help. In 1613 Capt. John Saris arrived at Hirado in the ship "Clove" with the object of establishing a trading factory for the East India company, and after obtaining the necessary concessions from the shogun, Adams postponed his voyage home (permission for which had now been given him) in order to take a leading part, under Richard Cocks, in the organization of this new English settlement.

He had already married a Japanese woman, by whom he had a family, and the latter part of his life was spent in the service of the English trading company, for which he undertook a number of voyages to Siam in 1616, and Cochin-China in 1617 and 1618. He died May 16, 1620, some three years before the dissolution of the English factory. His Japanese title was Anjin Sama, and his memory was preserved in the naming of a street in Yedo, Anjin Cho (Pilot street), and by an annual celebration on June 15 in his honour.

BIBLIOGRAPHY.—C. W. Hillary, *England's Earliest Intercourse with Japan* (1905); N. Murakami (ed.), *Letters Written by the English Residents in Japan* (1900, containing Adams' letters reprinted from *Memorials of the Empire of Japan* ed by T. Rundall, Hakluyt Society, 1850); *Diary of Richard Cocks,* with preface by N. Murakami (1899, reprinted from the Hakluyt Society ed. 1883); R. Hildreth, *Japan* (1855); J. Harris, *Navigantium atque Itinerantium Bibliotheca,* i, 856 (1764); Sir E. M. Satow (ed.), *Voyage of John Saris* (Hakluyt Society, 1900); *Asiatic Society of Japan Transactions* xxvi (sec. 1898), pp. 1 and 194, where four more hitherto unknown letters of Adams are given, *Collection of State Papers; relating to China and Japan.* The ms. of his logs written during his voyages to Siam and China is in the Bodleian library at Oxford.

**ADAMS, WILLIAM TAYLOR** (1822–1897), U.S. juvenile writer, popularly known under the pseudonym of "Oliver Optic," was born in Medway, Mass., on July 30, 1822. For 20 years he was a teacher in the public schools of Boston, and he served for a term in the state legislature. He wrote more than 100 books, chiefly juvenile fiction, which appeared in several series. In large part these were contributed to *Oliver Optic's*

*Magazine,* of which he was founder and editor. Among the best known are "Boat Club" series (1854), "Riverdale Story Books" (1858), "Woodville Stories" (1863–67), "Army and Navy" series (1865–1894), "Starry Flag" series (1867–69), "Young America Abroad" series (1867–69), "Great Western" series (1875–82), "Yacht Club" series (1900–03). He wrote also two novels, *The Way of the World* (1867) and *Living Too Fast* (1876). He died in Boston on March 27, 1897.

**ADAMS,** a town of Berkshire county, Mass., U.S., near the northwest corner of the state, including part of the valley of the Hoosac river, and extending from the Hoosac mountains on the east to Mt. Williams (3,040 ft.) and Mt. Greylock (3,491 ft.) on the west. Area 23 sq mi.; pop. (1950) 12,027; (1940) 12,608, of whom 2,480 were foreign-born whites Adams is on a branch of the Boston and Albany railroad, and is the nearest railway station for an ascent of Mt. Greylock It is an industrial centre, with textile printing, cotton mills, paper mills and lime quarries. The town (originally East Hoosuck) was surveyed in 1749 and incorporated in 1778. It was named after Samuel Adams, the revolutionary leader. North Adams was made a separate township in 1895.

**ADAM'S APPLE,** the prominence in the middle of the front of the neck which moves up and down with swallowing. It is more noticeable in men than in women. It is formed by the thyroid cartilage of the larynx, which is commonly known as the voice box. It is sensitive to pressure and blows and is vulnerable to attack in systems of personal combat.

**ADAM'S BRIDGE** or **RAMA'S BRIDGE,** a chain of sandbanks between the Island of Manaar, near the north-west coast of Ceylon and the Island of Rameswaram, off the Indian coast, and lying between the Gulf of Manaar on the south-west and Palk Strait on the north-east. More than 30m. long, it seriously hinders navigation. Some of the sandbanks are dry, and no part of the shoal has a greater depth than 3ft. or 4ft. at high water. Though dredging operations were begun as early as 1838 they never succeeded in maintaining a channel for any save vessels of light draught and have now been abandoned. Geological evidence shows that this gap was once bridged by a continuous isthmus, which, according to temple records, was breached by storm in 1480. These banks and shoals are traditionally supposed to be the remains of a huge causeway constructed by Rama, the hero of the *Ramayana,* to facilitate passage of his army from India to Ceylon for the rescue of his abducted wife Sita.

**ADAM SCOTUS** (*c.* 1180), theological writer, sometimes called Adam Anglicus or Anglo-Scotus, was born in the south of Scotland in the first half of the 12th century. About 1150 he was a Premonstratensian canon at St. Andrews, and about 20 years later was perhaps abbot and bishop of Candida Casa (Whithorn) in Galloway. He gained a European reputation for his writings, which are of mystico-ascetic type, and include an account of the Premonstratensian order, a collection of festival sermons, and a *Soliloquia de instructione discipuli,* formerly attributed to his contemporary, Adam of St. Victor.

**ADAMSEN, AMANDUS HEINRICH** (1855–1929), Estonian sculptor, studied in St. Petersburg (Leningrad). In 1887 he produced a portrait in relief of Tsar Alexander III.; he then went to Paris, where he lived for several years. In 1891 he returned to his native land and lived alternately in Port Baltic and St. Petersburg.

Adamsen's technique in marble and wood was moulded on classical lines. His small wood carvings are incomparable. His most important works are an allegory, shown at the Paris Exhibition in 1889, entitled "Liebe, Tod und Wissenschaft"; "Die Welle," and "Hunger"; also "Befreiter Genius" and "Sieg der Arbeit," which were executed for the Nijni-Novgorod Exhibition.

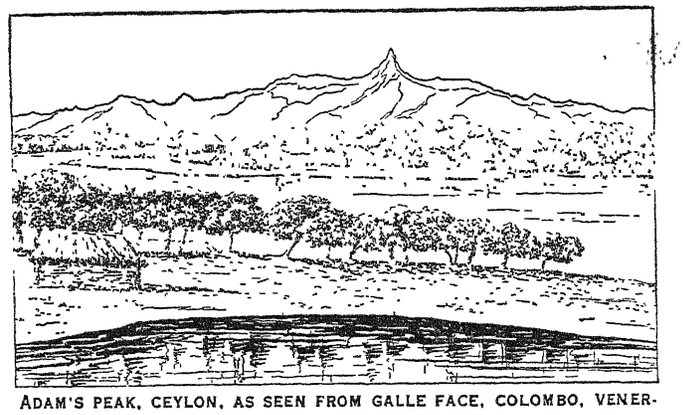
**ADAMSON, PATRICK** (1537–92), Scottish divine, Archbishop of St. Andrews, was born at Perth and educated at St. Andrews. He then spent some years in Paris, and was in hiding for seven months after the massacre of St. Bartholomew. He returned to Scotland in 1572, and in 1576 was appointed Archbishop of St. Andrews. He came into acute conflict with the General Assembly, and was twice excommunicated, though in each case the sentence was remitted. The last years of his life were spent in poverty His collected works, which include Latin verse translations of the books of Job and Revelation, were printed in 1614.

**ADAMSON, ROBERT** (1852–1902), Scottish philosopher, was born in Edinburgh on Jan. 19, 1852. After a distinguished career at Edinburgh university he spent some time at Heidelberg (1871), where he began his study of German philosophy. He then returned to Edinburgh as assistant, first to Henry Calderwood and later to A. Campbell Fraser; he joined the staff of the *Encyclopædia Britannica* (9th ed) (1874). In 1876 he succeeded W S. Jevons in the chair of logic and philosophy at Owens college, Manchester. In 1893 he went to Aberdeen, and finally, in 1895, to the chair of logic at Glasgow, which he held till his death on Feb 5, 1902. At Glasgow university he accomplished a great deal of useful administrative work and left a substantial impress on its constitution.

In 1903, under the title *The Development of Modern Philosophy and Other Essays,* his more important lectures were published with a short biographical introduction by Prof. W. R. Sorley of Cambridge university (see *Mind,* xiii. p. 73 *seq*) (1904). Most of the matter is taken verbatim from the notebook of one of his students. Under the same editorship there appeared, three years later, his *Development of Greek Philosophy.*

Throughout his lectures Adamson pursued the critical and historical method without formulating a constructive theory of his own. He felt that any philosophical advance must be based on the Kantian methods. As he grew older his metaphysical optimism waned. He felt that the increase of knowledge must come in the domains of physical science. Adamson represented an empiricism which, so far from refuting, was actually based on, idealism, and yet was alert to expose the fallacies of a particular idealist construction (*see* his essay in *Ethical Democracy,* edited by Dr. Stanton Coit).

**ADAM'S PEAK,** a mountain in Ceylon, about 45 mi E of Colombo, in 6° 55′ N., 80° 30′ E. It rises steeply to a height of 7,360 ft and commands a magnificent prospect. Its conical summit terminates in an oblong platform, 74 ft. by 24, on which there is a hollow, resembling the form of a human foot, 5 ft. 4 in. by 2 ft. 6 in. It is held in veneration by Buddhists, Mohammedans and Hindus alike, and by them is respectively ascribed to Gautama, to



ADAM'S PEAK, CEYLON, AS SEEN FROM GALLE FACE, COLOMBO, VENERATED BY THE SINHALESE. PILGRIMS ASCEND TO THE SACRED SPOT

Adam and to Siva It is in charge of Buddhist monks, and is the resort of large numbers of pilgrims At dawn the peak frequently casts a very well-defined shadow upon the clouds. It can be reached from Hatton on the railway or from Ratnapura.

**ADANA.** (1) A vilayet in S.E. Asia Minor, Turkey, including the ancient Cilicia. Pop. (1950) 509,600. Land area, 6,663 sq.mi. The mountain districts are rich in unexploited mineral wealth, and the fertile coast-plain, watered by streams from the Taurus, produces cotton, rice, cereals, sugar and much fruit, and affords abundant pasturage Imports and exports pass through Mersina (*q.v.*). (2) The chief town of the vilayet, in the alluvial plain about 30 mi. from the sea in 37° 1′ N., 35° 18′ E., on the right bank of the Seihan (Sihun, anc Sarus), navigable by small craft as far as the town. Adana is connected with Tarsus and Mersina

by a railway built in 1887, and has a magnificent stone bridge, carrying the road to Missis and the east, and dating in parts from the time of Justinian, but restored first in A.D. 743 and called Jisr al-Walid after the Omayyad caliph of that name, and again in 840 by Caliph Mutasim. There are, also, a ruined castle founded by Harun al-Rashid in 782, fine fountains, good buildings, river-side quays and cotton mills. Adana was a station on the Roman military road to the east and was largely rebuilt by Mansur in 758. Its position, commanding the passage of the mountains to the north of Syria, led to many vicissitudes. In the contest between Egyptians and Turks in 1832, after the defeat of the Turkish army at Konia, it was granted to Ibrahim Pasha, and though the firman named him only *muhassil,* or collector of the crown revenue, it continued to be held by the Egyptians till the treaty of July 1840 restored it to the Porte. The chief [illegible] of the province are cotton, corn, sesame and wool, [illegible] Pop. (1950) 117,799. The vilayet and city have been [illegible]

**ADANSON, MICHEL** (1727–1806), French naturalist of Scottish descent, was born at Aix-en-Provence. He travelled in Senegal and published an *Histoire naturelle du Sénégal* (Paris, 1757). Adanson's chief work was done as a botanist. In his *Familles naturelles des plantes* (1763) he opened the way for the natural classification of plants developed later by A. L de Jussieu in his *Genera Plantarum* (1780). He also left a vast unfinished encyclopaedia on all known beings and substances, which has never been published

**ADAPA, MYTH OF.** Adapa was a legendary sage, a citizen of Eridu, a city of Babylonia. Endowed with vast intelligence by the God Ea, he became the hero of the Eridu myth of the Fall of Man. Adapa, in spite of his possession of all wisdom was denied immortality; and one day, while fishing, the south wind blew so violently that he was thrown into the sea. In his rage he broke the wings of the south wind which then ceased to blow. Anu, the god of heaven, summoned him before his gates to receive punishment, but jealous Ea (god of wisdom) cautioned him not to touch the bread and water which would be offered him. When Adapa came before Anu, Tammuz and Gishzida interceded for him and explained to the god of heaven that as Adapa had been endowed with omniscience he needed only immortality to become a god; Anu then offered Adapa the bread and water of eternal life, which he refused to take. Thus mankind became mortal. (See *The Cambridge Ancient History,* vol. i [1924].)

**ADAPTATION,** a process of fitting, or modifying, a thing to other uses and so altering its form or original purpose. In literature there may be; *e.g.,* an adaptation of a novel for a drama, or in music an arrangement of a piece for two hands into one for four, etc. In biology, adaptation plays a prominent part as the process by which an organism or species becomes modified to suit the conditions of its life. Every change in a living organism involves adaptation; for in all cases life consists in a continuous adjustment of internal to external relations. Some adaptations are produced afresh in each generation, others are transmitted by heredity, having been probably fixed by natural selection. (*See* EVOLUTION, ORGANIC; SELECTION; VARIATION.)

**ADDA** (anc. *Addua*), a river of north Italy. It rises in small lakes of the Fraele glen and unites with several smaller streams near Bormio, in the Rhaetian Alps. Thence it flows southwest and west through the fertile Valtellina (*q.v.*) passing Tirano; the Poschiavino joins it at Tirano and the Malero at Sondrio. It falls into the northern end of the Lake of Como. On issuing from the southeast or Lecco arm, it crosses the plain of Lombardy, and, after about 150 mi., joins the Po 8 mi. above Cremona. The lower Adda once bounded the territories of Venice and Milan. At Trezzo, 20 mi. N.E. of Milan, there is a hydroelectric power plant.

**ADDAMS, JANE** (1860–1935), U.S. social reformer, was born at Cedarville, Ill., Sept. 6, 1860. After graduating from Rockford college, Rockford, Ill. (A.B., 1882), she entered the Woman's Medical college of Philadelphia, Pa., but her health failed, and after two years of invalidism she travelled extensively in Europe, where she visited Toynbee hall, London, Eng. After her return she founded Hull house, a pioneer social settlement in the old Hull mansion on Chicago's west side, where well-known social reformers lived as residents. In this large settlement she worked with labour and other reform groups for many pioneer welfare laws such as the first juvenile court law and the first "mother's pension" law, tenement house regulation, an eight-hour law for women, factory inspection and workmen's compensation. She was also an able supporter of woman suffrage. A well-known pacifist, she was chairman of the International Congress of Women at The Hague, Neth., in 1915, following which the Women's International League for Peace and Freedom, of which she became president, was established. She was cowinner of the Nobel peace prize in 1931 She was the first woman president of the National Conference of Social Work (1910) and took an active part in the Progressive campaign with Theodore Roosevelt in 1912. Author of many books and articles, she used her influence for social justice for the immigrant, for the Negro, for labour and for the rights of women and children She died in Chicago on May 21, 1935. (E. AT.)

**ADDAX,** a genus of antelopes, with one species (*A. nasomaculatus*) from North Africa and Arabia. It is 3 ft high, yellowish white in colour, with a brown mane and fringe on the throat. Both sexes carry horns, which are ringed and form an open spiral. The addax is a desert antelope, living in regions where it seldom rains and getting its necessary moisture from the desert plants.

**ADDER,** a name for the common viper (*Vipera berus*) of Europe and Asia. The puff-adder (*Bitis arietans*), widespread in Africa, and the death-adder (*Acanthophis antarcticus*), of Australia, are very poisonous. In North America the original meaning of "any snake" tends to be preserved, as for the harmless hognose snake (*Heterodon contortrix*), which hisses loudly and is called the puffing adder or spreading adder. *See* HOGNOSE; VIPER.

ADDICT, DRUG: *see* DRUG ADDICTION.

ADDING MACHINE: *see* OFFICE APPLIANCES.

**ADDIS ABABA** (the new flower), capital of Ethiopia since 1896, about 8,000 ft above sea level on the southern slopes of the Entoto Mts. in 9° 1′ N., 38° 56′ E. It is the centre of trade and is linked by a single railway line (486.5 mi.) with Jibuti in French Somaliland on the Gulf of Aden and by roads, built for the most part by the Italians, to Asmara, Assab, Jimma, etc. After the completion of the railway in 1918 Addis Ababa underwent much change. It is embowered in woods of eucalyptus planted by Emperor Menelek and is watered by small tributaries of the Awash river, notably the Akaki and the Kabana. The normal population is about 150,000, but at feast times thousands of followers of the chiefs and provincial governors attend court. The foreign legations are quartered in well built houses in large grounds on the outskirts of the town. After the visit of Emperor Haile Selassie to Europe in 1924 motor cars were imported into the town. The central market place is the daily rendezvous of immense numbers of peasants and traders dealing in local and imported cotton and other goods. The city suffered somewhat from bombs dropped during the Italian war on Ethiopia in 1935–36. Numerous buildings, including government offices and hospitals, were erected during the Italian occupation. The Ethiopian government has embarked on a program of modernization for the city. Electric and water facilities exist. Radio and telephone communications are to be extended, as are commercial air routes. Most of the few industries of Ethiopia are in or near the city: flour mills, cotton processing plants, ice, carbonated water and beer plants, machine shops, etc. The city was captured by the Italians, May 5, 1936, and soon after became the capital of Italian East Africa. It was taken by British and Ethiopian troops, April 5, 1941. The emperor returned May 5, 1941. (P. W. I.)

**ADDISON, JOSEPH** (1672–1719), English essayist, poet and man of letters, eldest son of Lancelot Addison, later Dean of Lichfield, was born at his father's rectory of Milston in Wiltshire, on May 1, 1672. After having attended several schools, the last Charterhouse, he was entered a commoner of Queen's college, Oxford, at the age of 15; but after two years was elected to a demyship of Magdalen college for his skill in Latin versification. He took his master's degree in 1693 and subsequently obtained a fellowship which he held until 1711. Much of his early Latin verse is preserved in the *Musae Anglicanae* (1691–99). A

poem in the third volume of Dryden's *Miscellanies* followed in the next series by a translation of the fourth *Georgic*, brought about his introduction to Tonson the bookseller, and (probably through Tonson) to Lord Somers and Charles Montagu. To both of these persons he commended himself by *An Account of the Greatest English Poets* (1694), *An Address to King William* (1695), after Namur, and a Latin poem entitled *Pax Gulielmi* (1697), on the Peace of Ryswick, with the result that in 1699 he obtained a pension of £300 a year to enable him (as he afterwards said in a memorial addressed to the Crown) "to travel and qualify himself to serve his Majesty." In the summer of 1699 he crossed into France, where, chiefly for the purpose of learning the language, he remained till the end of 1700; and after that he spent a year in Italy. In Switzerland, on his way home, he was stopped by receiving notice that he was to attend the army under Prince Eugene, then engaged in the war in Italy, as secretary from the King. But in March 1702 the death of King William at once drove his Whig friends from power and Addison's pension ceased He was able, however, to visit a great part of Germany, and did not reach Holland till the spring of 1703. In the autumn of the same year Addison returned to England.



AFTER THE STATUE IN WEST MINSTER ABBEY

ADDISON WHO, WITH STEELE, DELIGHTED THE TOWN WITH THE "SPECTATOR"

During his residence abroad he wrote the rhymed *Letter from Italy* to Charles Montagu, the *Dialogues on the Usefulness of Medals,* not published until after his death, and the *Remarks on several parts of Italy,* printed in 1705. After his return to England he was asked by Lord Halifax to write a poem celebrating Marlborough's victory at Blenheim. This, *The Campaign* (1704), won for its author a post in the excise, which was practically a sinecure. The next ten years of his life were spent in government service as an under-secretary of State, secretary to Lord Halifax on a mission to the Elector of Hanover (1708), and secretary to Lord Wharton, the lord lieutenant of Ireland (1708–10). His commissionership in the excise he retained all his life, and he sat in Parliament, a silent member, from 1708 onwards, first for Lostwithiel and then for Malmesbury. During this period he wrote an anonymous pamphlet in defence of the Government entitled *The Present State of the War* (1707), and an opera libretto, *Rosamond,* complimenting the Duke of Marlborough, which was a failure at the time, but was afterwards set to music by Dr. Arne with great success. In 1711 he purchased for £10,000 the estate of Bilton near Rugby.

Soon after the fall of the ministry, he started the *Whig Examiner* in opposition to the Tory *Examiner,* then conducted by Prior, and afterwards the vehicle of Swift's most vehement invectives against the party to which he had once belonged These are certainly the most ill-natured of Addison's writings; but they are neither lively nor vigorous, and the paper died after five numbers (Sept. 14 to Oct. 12 1710). There is more spirit in his allegorical pamphlet, *The Trial and Conviction of Count Tariff.* But meanwhile Addison found his real vocation as one of the greatest of English essayists. Richard Steele, who had been Addison's schoolfellow at the Charterhouse, remained on intimate terms with him and belonged to the same political party. Addison was in Dublin when, in April 1709, Steele published the first number of the "Tatler." He is said to have detected his friend's authorship only by recognizing in the sixth number a critical remark on Virgil, which he remembered having himself communicated to Steele. He began to furnish hints and suggestions, assisted occasionally and finally wrote regularly. According to Aitken (*Life of Steele,* i. 248), he contributed 42 out of the total of 271 numbers, and was part-author of 36 more. With the advent of Addison as a contributor the character of the "Tatler" changed. The essay began to preponderate, and the news element almost disappeared. The paper was discontinued from Jan. 2, 1711, perhaps because its semi-political character made Steele's position difficult under the Tory administration. But after a very short time it had a successor in the "Spectator," in which Addison played the leading part The paper was to be non-political, and was to "bring philosophy out of the closets and libraries, schools and colleges, to dwell in clubs and assemblies; at tea-tables and in coffee-houses" (*Spectator* No. 10).

**The first number** appeared on March 1, 1711; the paper was issued daily until Dec. 6, 1712. In the "Tatler" the papers on different subjects had been dated from various clubs; in the "Spectator" the framework is supplied by an imaginary club grouped round the "Spectator" Mr. Spectator himself, whose character is portrayed in the first number, represents a new and more sober England, very different from the court circles of the time. He is learned, thoughtful, serious, yet with a pleasant humour; he frequents the coffee-houses, and his observant eye notes the new spirit growing up under the older forms of society. His fellow club members represent different types. Sir Roger de Coverley is the old English country gentleman; Sir Andrew Free port represents the great London merchant class; Captain Sentry is the good-humoured soldier discharged in civil life, Will Honeycomb the man of fashion, while the Templar stands for learning and wit, and so on

For nearly two years the "Spectator" delighted the town. The "Spectator" stood for reason and moderation in an age of bitter party strife, for clean living in an age when the English upper classes had not yet recovered from the licence of the Restoration, and in criticism for the best standards of its time. Addison and Steele were for a reconciliation of the harsh austerities of Puritanism with the careless profligacy of the Restoration. They were, in fact, great moralists Samuel Johnson, whose political sympathies did not make him too friendly to Addison, paid his tribute to the lucidity and purity of his English style. "Whoever wishes to attain an English style," he said, "must give his days and nights to the volumes of Addison" And Macaulay speaks justly of Addison as the "consummate painter of life and manners," and of "the great satirist who alone knew how to use ridicule without abusing it; who, without inflicting a wound, effected a great social reform, and who reconciled wit and virtue, after a long and disastrous separation, during which wit had been led astray by profligacy and virtue by fanaticism." The "Spectator" includes the famous Saturday papers on Milton in which Addison applied the principles of Aristotelian criticism to Milton's work. However excessive his praise of Milton may seem (he placed him above Homer and Virgil), these papers had a great influence on criticism for a long period, and were translated into French and German.

Of the 555 papers in the "Spectator" Addison's numbered 274 against 236 written by Steele. W. J. Courthope estimated the circulation of the "Spectator" at 10,000—a very large number for those days—and the bound annual volumes had a further sale of 9,000. After the "Spectator," Steele projected the "Guardian," which was also to be non-political, but did not maintain its aloofness. Addison also contributed a few papers.

It is astonishing to some readers that Addison's tragedy of *Cato,* produced on April 13, 1713, should have been counted one of his best achievements. But the artificiality and frigidity of the piece, and its glaring faults even after the emendations of Pope and others, counted for very little against the political interest imported into the play. It was dedicated to the Duchess of Marlborough, and the liberal sentiments put into the mouths of Roman orators were taken as a glorification of Whig sentiments. It was interpreted as a defence of the Whigs and Marlborough against the Tories, who were suspected of trying to undo the Act of Settlement. *Cato* ran for 35 nights. It was translated into French and German, and Addison was praised by Voltaire as "the first Englishman who composed a regular tragedy and infused a spirit of elegance into every part of it." Voltaire's praise was partly due to Addison's strict adherence to the unity of place which his English contemporaries found unnatural and artificial.

From the cessation of the "Spectator" onwards, Addison's life, though outwardly increasingly prosperous, was clouded by various misunderstandings and quarrels. The rights and wrongs of Pope's quarrel with him (*see* POPE, ALEXANDER) are difficult to disentangle, and cannot be dealt with here. But Addison, who had established Button in a coffee-house in Covent Garden, held a little literary court there of which Budgell, Tickell, Carey and Phillips were members. Pope was not a member of the coterie, though it appears that he made a brief appearance there. In any case there was a complete breach. Pope wrote the famous lines on Atticus in the *Epistle to Dr. Arbuthnot* in which Addison is mercilessly attacked as "willing to wound, and yet afraid to strike," who "like Cato, gives his little senate laws, and sits attentive to his own applause." The *Epistle* was not published until after Addison's death, though he must have seen the lines.

On the accession of George I., Addison was appointed secretary to the lords justices entrusted provisionally with the conduct of the Government until the new King's arrival. He then became once more chief secretary for Ireland. He defended the Hanoverian succession against the Jacobite partisans in a new paper called the "Freeholder" which appeared bi-weekly between Dec. 23, 1715 and June 9, 1716. Probably in return for this service he was made one of the commissioners for trade and the colonies. In Aug. 1716 he married Charlotte, Countess dowager of Warwick, who brought her husband the occupancy of Holland House, Kensington. The common report that the marriage was a very unhappy one is based mainly on the evidence of Addison's enemies. The allegations that he was incompetent in the public service are derived from similar sources; but as one of the secretaries of State in the Sunderland cabinet (1717) he seems to have been a failure. He resigned on the plea of failing health in March 1718. In the same month he found himself ranged as a pamphleteer against his old friend Dick Steele. The contest was still proceeding when Addison died of dropsy, June 17, 1719. Steele's real love for his friend was shown in the letter to Congreve prefixed to Addison's anonymous comedy *The Drummer,* acted in 1716.

Addison's life was written in 1843 by Lucy Aikin. This was reviewed by Macaulay in July of the same year. A more modern study is that in the "Men of Letters" series by W. J. Courthope (1884). The *Spectator* (seven vols. 1712–13, the 8th being added in 1715), was frequently reprinted. There is a good modern edition, in eight vols. (1897–98) by G. Gregory Smith. Of the *Tatler* there is an edition by G. A. Aitken in eight vols. (1898). A complete edition of Addison's works (based upon Hurd) is included in Bohn's *British Classics;* Bonamy Dobree, *Essays in Biography* (1925).

**ADDISON'S DISEASE,** a morbid state first described by Thomas Addison in 1855, has as prominent features of its syndrome asthenia, marked weakness, low blood pressure, loss of weight, irritability of the gastrointestinal tract and, usually, pigmentation. The cause of the symptoms is deficiency of adrenal cortical function, but there is more than one reason for failure of the cortical tissue.

The most common lesion is caseation associated with tuberculosis. Atrophy of the gland without infection is found in 20% or more of the cases.

Life in the presence of Addison's disease has been difficult and precarious. Any condition which resulted in loss of sodium and chloride, as excessive perspiration or a diet with high content of potassium and low sodium, could cause prostration or death. Physical exertion, strain from a surgical operation or administration of an anaesthetic alone, has been sufficient to precipitate a critical condition.

Diagnosis of Addison's disease in its severe form is not difficult, but demonstration of limitation of adrenal cortical function requires objective laboratory tests. Under closely controlled conditions, determination of the ability of the kidney to retain sodium and chloride or to excrete water furnishes reliable information concerning adrenal cortical activity. Patients with Addison's disease have survived without adequate treatment for months or a few years, but before recognition of the relation of sodium potassium and chloride to the severity of the symptoms a fatal termination was almost certain.

Robert Loeb in 1932 discovered that if the loss of sodium chloride was stopped by the daily administration of large amounts of this salt, clinical improvement was often marked and sustained. The unfavourable effect of potassium was shown in 1937, and a rational treatment of Addison's disease based on the control of mineral metabolism provided relief but not a satisfactory solution of the problem. In 1930 an extract of the adrenal cortex was made available for patients in a critical condition but this material remained scarce, not always reliable and very expensive. The availability of desoxycorticosterone in 1937 made it possible to control mineral metabolism.

However, since desoxycorticosterone tended to increase the concentration of sodium and decrease that of potassium in the blood when large amounts of this compound were used, it was necessary to limit the intake of sodium and increase potassium in the diet. Many patients have been greatly benefited by this treatment, but few of them were restored to a state of well-being and some patients died even though the electrolytes in the blood were within normal limits. It became evident that something more than control of mineral metabolism was essential. Cortisone, a hormone of the adrenal cortex which influences organic metabolism and many diverse physiologic processes, was not available until this compound was prepared on a commercial scale in 1948. In 1949 it was shown that a daily dose of about 15 mg. of cortisone and 1 to 5 mg of desoxycorticosterone restored strength and a sense of well-being to patients who had Addison's disease. Treatment with cortisone alone was not satisfactory because sodium and chloride were rapidly lost from the body; but when the mineral metabolism was controlled with desoxycorticosterone and at the same time cortisone was administered, the patient was able to resist fatigue and to enjoy an almost normal state of health.

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**"ADDLED PARLIAMENT,"** the name usually given to the English parliament which met on April 6, 1614, sat for two months of violent debate, and was finally dissolved by James I. without having passed a single bill. Seven years passed before another parliament was summoned.

**"ADDRESS, THE,"** an English parliamentary term for the reply of the Houses of Parliament (and particularly of the House of Commons) to the speech of the sovereign at the opening of a new parliament or session. There are certain formalities which distinguish this stage of parliamentary proceedings. The "King's Speech" itself is divided into three sections: the first, addressed to "My Lords and Gentlemen," touches on foreign affairs; the second, to the "Gentlemen of the House of Commons," has reference to the estimates; the third, to "My Lords and Gentlemen," outlines the proposed legislation for the session. Should the sovereign in person open parliament, he does so in the House of Lords in full state, and the Speaker and members of the House of Commons are summoned there into the royal presence. The sovereign then reads his speech. If the sovereign is not present in person, the speech is read by commission. The Commons then return to their House, and an address in answer is moved in both Houses. But before this motion a bill is read *pro forma,* a survival of an ancient claim of the Commons to assert their right of deliberation on subjects other than the Crown's immediate cause of summons. The Government of the day selects two of its supporters in each House to move and second the address, and when carrying out this honourable task they appear in levee dress. Previous to the session of 1890–91, the royal speech was answered paragraph by paragraph, but "the address" is now moved in the form of a single resolution, thanking the sovereign for his most gracious speech. The debate on the address is used as a means of ranging over the whole Government policy, amendments being introduced by the Opposition. A defeat on an amendment to the address is generally regarded by the Government as a vote of no-confidence. After the address is agreed to it is ordered to be presented to the sovereign. The thanks of the sovereign for the address are then conveyed to the Lords by the lord steward of the household and to the Commons by the comptroller of the household.

**ADDRESSING MACHINE**: *see* OFFICE APPLIANCES.

**ADE, GEORGE** (1866–1944), U.S. author, was born at Kentland, Ind., on Feb. 9, 1866. After graduating from Purdue University in 1887, he took up newspaper work in Lafayette, Ind., and Chicago (1887–1900). Although he belonged to the school of American vernacular humorists, he was definitely an urban product. Many of his early books, such as *Artie* (1896) and *Doc' Horne* (1899) were designated as stories "of the streets and town" and were adapted from his newspaper contributions. His best-known book, *Fables in Slang* (1899), is clever and sophisticated. Ade wrote a number of musical comedy librettos, film scenarios, including *Back Home and Broke* (1922), and plays, the best known of which were *The County Chairman* (1903), *The College Widow* (1904) and *Father and the Boys* (1908). He died May 16, 1944.

**ADELA** (1062?–1137), daughter of William the Conqueror and mother of Stephen, king of England, whose right to the throne derived through her. She was married to Stephen, earl of Meaux and Brie in 1080 at Breteuil Upon the death of his father in 1090, her husband succeeded to the earldom of Blois and Chartres. She took an active interest in civil and ecclesiastical affairs and was instrumental in rebuilding the cathedral of Chartres in stone. In 1095 she became regent when her husband, at her urging, took part in the first crusade to the Holy Land. He returned in 1099, but left to join the second crusade in 1101 and was killed in battle at Ramula. Adela continued as regent during the minority of her sons and was increasingly active in public life. Anselm, her guest and teacher in 1097, was often entertained by her during 1103 and 1105 and she affected a temporary reconciliation between him and her brother, Henry I. In 1107 Adela entertained Pope Pascal during Easter and in the following year was hostess to Boemund of Antioch. She made her son Theobald successor to her rule in 1109 and entered a convent in the diocese of Autun, continuing to wield an important influence in public and clerical affairs. She persuaded Theobald to join with her brother Henry I against France in 1117 and was a benevolent patroness of churches and monastaries. She died in 1137 and was buried at Caen.

**ADELAER** or ADELER, the surname given to KURT SIVERTSEN (1622–75), Norwegian-Danish sailor. Born at Brevig, in Norway, he entered the Dutch navy and then the Venetian service, where he was known as Curzio Suffrido Adelborst (*i.e.*, Dutch for "naval cadet"). He commanded the Venetian squadron at the battle of the Dardanelles (May 13, 1654) when his ship alone sank 15 Turkish galleys and burned others. Next day he compelled the surrender of the Turks at Tenedos. In 1660 he became admiral-lieutenant in the Venetian service, but in 1662 he was induced to take command of the Danish fleet. Under Christian V he took command of the combined Danish fleets against Sweden, but he died before the expedition.

**ADELAIDE** (ADELHEID) (931–999), queen of Italy and empress, was the daughter of Rudolph II of Burgundy, and married, in 947, Lothair, who succeeded his father Hugh as king of Italy. Lothair died in 950 and Adelaide was imprisoned at Como by his successor, Berengar II, marquis of Ivrea, who wished to compel her to marry his son Adalbert. After four months (August 951) she escaped and took refuge at Canossa with Atto, count of Modena-Reggio. Meanwhile Otto I, the German king, whose English wife, Edgitha, had died in 946, came to Italy. Adelaide met him at Pavia, and at the close of the year the marriage took place. On Feb. 2, 962, she was crowned empress at Rome by Pope John XII immediately after her husband, and she accompanied Otto in 966 on his third expedition to Italy, where she remained with him for six years.

After Otto I's death (May 7, 973), Adelaide exercised for some years a controlling influence over her son, the new emperor, Otto II. The causes of their subsequent estrangement are obscure, but it was possibly due to the empress' lavish expenditure in charity and church building, which was a serious drain on the imperial finances. In 978 she left the court and lived partly in Italy, partly with her brother Conrad, king of Burgundy, by whose mediation she was ultimately reconciled to her son. In 983, shortly before his death, she was appointed his viceroy in Italy, and, in concert with the Empress Theophano, widow of Otto II, and Archbishop Willigis of Mainz, defended the right of her infant grandson, Otto III, to the German crown against the pretensions of Henry the Quarrelsome, duke of Bavaria.

In June 984 the infant king was handed over by Henry to the care of the two empresses; but the masterful will of Theophano soon obtained the upper hand, and until the death of the Greek empress, on June 15, 991, Adelaide had no voice in German affairs. She assumed the regency, in concert with Archbishop Willigis and a council of princes of the empire, and held it until in 995 Otto was declared of age. In 996 the young king went to Italy to receive the imperial crown; and from this date Adelaide devoted herself to pious exercises, to correspondence with the abbots Majolus and Odilo of Cluny, and to the foundation of churches and religious houses.

She died on Dec. 17, 999, and was buried in the convent of Saints Peter and Paul, her favourite foundation, at Salz in Alsace.

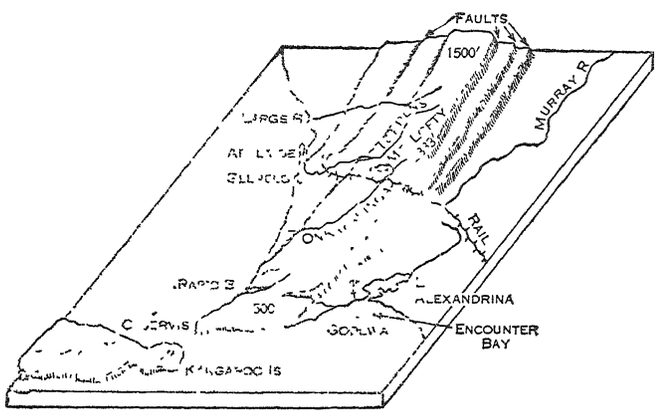
By the emperor Otto I she had four children: Otto II (d. 983); Mathilda, abbess of Quedlinburg (d. 999); Adelheid (Adelaide), abbess of Essen (d. 974); and Liutgard.

BIBLIOGRAPHY—Adelaide's life (*Vita* [illegible] *Adalheidae imperatricis*) was written by St. Odilo of [illegible] valuable only [illegible] years, the rest of her life being merely outlined, though her adventures in escaping from Berengar are treated in more detail The best edition is in André Duchesne, *Bibliotheca Cluniacensis*, pp. 353–362. *See* Giov. Batt. Semeria, *Vita* [illegible] *di s. Adeleida, etc.* (Turin, 1842); Jul. Bentzinger, *Das Leben der Kaiserin Adelheid . . . wahrend der Regierung Ottos III.*, Inaug. Dissertation (Breslau, 1883); J. J. Dey, *Hist de s. Adelaide, etc.* (Geneva, 1862); F. P Wimmer, *Kaiserin Adelheid, Gemahlin Ottos I des Grossen* (Regensburg, 1889); W. Wattenbach, *Deutschlands Geschichtsquellen* (Stuttgart and Berlin, 1904). *See* Ulysse Chevalier [illegible] *sources historiques* (1903).

**ADELAIDE,** capital of South Australia, in the county to which it gives its name, is situated near the middle of the eastern side of St. Vincent gulf where the coast line curves farthest inland (eastward). The genius of Charles Sturt, and then of William Light, the first surveyor-general, selected (1836) a site upon fertile plains which swept up very gently from the coast to a curving line of hills some 9 mi. inland. (Mt. Lofty, *c.* 7 mi. [ air line] E.S.E. of Adelaide, 2,333 ft.) Light chose, not without opposition, a spot on rising ground, close to the Torrens stream, the chief early source of water supply, and within easy reach of a fair open roadstead (Holdfast bay, *c.* 6 mi ). Within 8 mi. also was the only considerable sheltered inlet along this recently elevated coast, the Port Adelaide "river," a deflected tidal estuary. This water—shallow, muddy, but improved by dredging—became the site of Adelaide's port until the construction of the outer harbour provided a more accessible anchorage for larger vessels near the mouth of the estuary and facing the open gulf. Southward the hills close in upon the plain and meet the coast line, but northward the lowlands stretch, broadening, up to and beyond the head of the gulf. Easy movement was possible also by various gaps and saddles to the Murray lowlands in the east and southeast, and Adelaide thus soon became an important nodal point for lines of movement by land and sea. The fertility of the plains—deep alluvium washed down from the torrent-scarred hills—the presence of minerals (though in relatively small quantities) in the hills, and the genial climate formed the basis of Adelaide's prosperity. A fairly regular rainfall of *c.* 21 in. falling largely in the winter months (April–November); temperatures hot in summer (Jan. mean: 73°; highest recorded [shade] maximum 116°, with fairly frequent heat spells); but cool and bracing in winter (June mean: 52° with occasional frosts); land and sea breezes along the coast and much sunshine make up a typical Mediterranean climate. The town was laid out by Light in the form of a square, divided into rectangular blocks with gardens and parks at the points of intersection. Around the square a mile-broad belt of park land was reserved, and beyond these stretch the suburbs. The park lands have been to some extent encroached upon for public buildings, but the remainder form the great playground and "lungs" of the city which claims to have no slums. The

climate and the presence of the river Torrens, now artificially dammed and converted into a lake, lend Adelaide the peculiar charm of diversified vegetation; northwestern European, southern European and subtropical.

After a somewhat chequered early history Adelaide, in virtue of its commanding situation in relation to all the more important southern parts of the state, steadily grew in prosperity and size until, with 312,619 inhabitants, it had a decidedly alarming proportion (nearly 54%) of the total population of the state (1933, 580,949); 1943 estimate, 362,500. Its commercially central position and good communications, ready supplies of raw materials and of imported coal, and a protective tariff have built up in the metropolitan area (particularly along the main lines to Port Adelaide) a number of flourishing young industries, manufacturing woollens, machinery, pottery, etc. To Adelaide gravitate the products of the agricultural and pastoral areas of the surrounding fertile districts, and thither also, for lack of a river-mouth port, come the bulk of the products—wool, wheat, fruit—of the lower Murray valley (*see* ALEXANDRINA, LAKE). The trade of Port Adelaide is five to six times as valuable as that of any other South Australian port, and fourth as regards value and tonnage among the ports of Australia. In 1938–39 the imports at Port Adelaide were worth £5,500,000 and the exports £10,000,000. The city possesses many fine buildings, including the university, School of Mines, an Anglican and a Roman Catholic cathedral, exhibition building and others. It was the birthplace of municipal government in Australia and gained a lord mayoralty in 1919.




FROM TAYLOR, "AUSTRALIA" (METHUEN, 1940)

BLOCK DIAGRAM OF THE SITE OF ADELAIDE AT THE SOUTHERN END OF THE FLINDERS RANGE. THE BLOCK IS ABOUT 100 MI. WIDE

**ADELARD** or **AETHELARD** of Bath (12th century), English scholastic philosopher. He studied in France and travelled in Spain, Italy, north Africa and Asia Minor, where he became acquainted with Arabian scholarship. He returned to England in the time of Henry I, and received an annual grant from the revenues of Wiltshire. Adelard translated Euclid's *Elements,* probably from an Arabic version. The work, which was published in Venice in 1482 under the name of *Campanus de Novara,* at once began to be used as a textbook in the schools. Adelard's special contribution to scholastic philosophy was the treatise *De eodem et diverso,* in which he enunciated the theory of "indifference."

It is in the form of a dialogue between himself and his favourite nephew, and was dedicated to Richard, bishop of Bayeux from 1113 to 1133. He wrote also a group of treatises on the astrolabe (a copy of which is in the British museum), on the abacus (three copies exist in the Vatican library, the library of Leyden university and the Bibliothèque Nationale in Paris), translations of the Kharismian tables and an Arabic *Introduction to Astronomy.*

BIBLIOGRAPHY—*See* C. Jourdain, *Recherches sur les traductions d'Aristote* (2nd ed., 1843); Barthélemy Hauréau, *Philosophie scolastique* (2nd ed., 1872); and works appended to art. *See* also SCHOLASTICISM.

**ADELIE COAST,** Antarctic land situated on the polar circle in longitude 140° E., discovered by the Frenchman Dumont d'Urville in 1840. The steep coasts, rising to heights of from 3,250 to 4,000 ft., are almost unapproachable. Although covered with snow and ice and completely uninhabited, it has possibilities of utilization for whale fishing. (*See* also ANTARCTIC REGIONS.)

ADELSBERG: *see* POSTUMIA-GROTTE.

**ADELUNG, JOHANN CHRISTOPH** (1732–1806), German grammarian and philologist, was born at Spantekow in Pomerania, on Aug. 8, 1732. He was educated at the [illegible] of Anklam and Klosterbergen, and the University of [illegible]. In 1759 he was appointed professor at the gymnasium of Erfurt, but relinquished this position two years later to take up residence at Leipzig, where he devoted himself to philological researches and the voluminous writings he continued to produce throughout his life. In 1787 he was made principal librarian to the elector of Saxony at Dresden, where he lived until his death on Sept. 10, 1806.

By his grammars, dictionary and various works on German style, Adelung helped to rectify the orthography, refine the idiom and fix the standard of his native tongue. His German dictionary—*Grammatisch-kritisches Wörterbuch der hochdeutschen Mundart* (1774–86)—bears witness to his intimate knowledge of the history of the different dialects on which modern German is based. No man before Jacob Grimm (*q.v.*) did so much for the language of Germany. At the time of his death Adelung was engaged on a work on general philology, entitled *Mithridates, oder allgemeine Sprachenkunde.* Unfortunately he did not live to complete it.

The first volume, which deals with the Asiatic languages, was published immediately after his death; the other two were issued under the superintendence of Johann Severin Vater (1771–1826).

**ADEMPTION,** a taking away; in law, a revocation of a grant or bequest.

**ADEN,** seaport and territory in Arabia, situated in 12° 45′ N. and 45° 4′ E. on a peninsula near the entrance to the Red sea, 100 mi. E. of the Strait of Bab al-Mandab. The peninsula of Aden has barren and desolate volcanic rocks, rising to 1,776 ft. and extending 5 mi. from east to west and 3 mi. from its northern shore to Ras Sanailah, or Cape Aden, its most southerly point; it is connected with the mainland by a neck of low sandy ground. The town is built on the eastern coast, in the crater of an extinct volcano, and is surrounded by precipitous rocks forming an admirable natural defense.

There are two harbours: an outer, facing the town, protected by the island of Sirah, but partially choked with mud; and an inner, called Aden Back-bay, or, by the Arabs, Bandar Tawayih, on the western side of the peninsula. The new Aden, called Steamer Point, houses the U.S. and other consulates, the principal banks and shipping offices.

Drinking water, which was obtained before 1930 by condensing sea water, was later amply supplied by a pipe line from artesian wells on the mainland.

Aden early became the chief entrepôt of trade between Europe and Asia. It is the Ἀραβία εὐδαίμων of the *Periplus.* It was known to the Romans as *Arabia Felix* and *Attanae* and was captured by them, probably in the year 24 B.C. It was unsuccessfully attacked by the Portuguese under Albuquerque in 1513, but fell into the hands of the Turks in 1538. In the following century the Turks relinquished their conquests in Yemen, and the sultan of San'a established a supremacy over Aden, which was maintained until 1735, when the sheikh of Lahaj, throwing off his allegiance, founded a line of independent sultans.

From the 16th to the 19th centuries traffic between Europe and the east had mostly gone via the Cape of Good Hope. The annexation of Aden to British India in 1839 renewed trade between India and the Red sea and this developed enormously after the cutting of the Suez canal. Aden was made a free port and a coaling station, and its territory was extended by cession or purchase. The island of Perim in the Strait of Bab al-Mandab was occupied in 1857.

In addition to its east and west trade Aden developed many commercial relations with the interior and with the opposite coast of Africa. The chief imports are fuel oil, petrol (gasoline), coffee,

cotton piece goods, grain, hides, coal, sugar and tobacco. The exports are, in the main, the same as the imports. Aden itself produces salt and cigarettes. The trade is largely one of transshipment

Imports for 1949 amounted to Rs. 42,63,00,879[1]; exports to Rs 18,76,73,189. In that year 3,600 merchant ships of 15,924,948 tons (net) entered the port of Aden, besides 2,500 local craft.

The submarine cables of Cable and Wireless, Ltd., diverge there on the one hand to India, the far east and Australia; on the other, to Zanzibar and the Cape of Good Hope. There are no railways in the colony, and communications between the townships are by road

By mid-20th century there were several regular air services between Aden and Cairo (via Jibuti, Asmara and Khartoum, or via Jidda and Port Sudan); to Addis Ababa; and to Nairobi via Hargeisa and Mogadishu; and to Mukalla in the eastern Aden protectorate during the summer monsoon. The population of the Aden colony at the 1946 census was 80,876, of which 365 were of European and allied races.

**Boundaries and Administration.**—After the kingdom of the Yemen (*q.v.*) became independent of the Ottoman empire it refused to recognize the boundary between itself and the western Aden protectorate which was determined by the Anglo-Ottoman convention of 1905. The matter was left open by the Anglo-Yemeni treaty of Feb. 11, 1934, but it was agreed in Jan. 1951 to form a joint commission to demarcate frontiers and settle the disputes which had occurred from time to time. As a result of disputes concerning the border with Yemen, Great Britain and Yemen broke diplomatic relations in 1949; however, in March 1951 they were resumed.

On April 1, 1937, Aden passed from the control of the India office to the colonial office; its currency became the East African shilling in place of the rupee in June 1951. In Jan 1947 a legislative council was inaugurated, consisting of the governor, four ex-officio members, not more than four official members and not more than eight unofficial members representing the various communities.

The Aden protectorates, eastern and western, have an area of about 110,000 sq.mi. with an estimated population of 650,000 in 1950, organized into about 30 sultanates, sheikhdoms and other tribal units in treaty relations with the British government. The principal of these are the Qu'aiti state of Shihr and Mukalla and the Kathiri state of Sai'un, both in the eastern protectorate; and the 'Abdali sultanate of Lahaj in the western.

BIBLIOGRAPHY.—Colonial Office, London, *Annual Reports on Aden*, with further bibliography; the Master of Belhaven, *The Kingdom of Melchior* (London, 1949); Doreen Ingrams, *A Survey of Social and Economic Conditions in the Aden Protectorate* (Eritrea, 1949).

(G. E. K.)

**ADENÈS,** ADENEZ or ADANS, surnamed Le Roi, French trouvère, was born in Brabant about 1240. He owed his education to the kindness of Henry III, duke of Brabant, and he remained in favour at court for some time after the death (1261) of his patron.

In 1269 he entered the service of Guy de Dampierre, afterward count of Flanders, probably as *roi des ménéstrels*, and followed him in the next year on the abortive crusade in Tunis. The expedition returned by way of Sicily and Italy, and Adenès left in his poems some very exact descriptions of the places through which he passed.

The poems written by Adenès are four: the *Enfances Ogier, Berte aus grans piés, Bueves de Comarchis* and a long *roman d'aventures, Cléomadès*, borrowed from Spanish and Moorish traditions brought into France by Blanche, daughter of Louis IX. Adenès probably died before the end of the 13th century.

BIBLIOGRAPHY.—The romances of Adenès were edited for the Académie royale de Belgique (*Cléomadès* by A. van Hasselt, 1865–66; *Berte, Les Enfances Ogier, Bueves de Commarchis* by A. Scheler, 1874); *Berte* was rendered into modern French by G. Hecq (1897) and by R. Périé (1900); *Cléomadès*, by Le Chevalier de Chatelain (1859). *See* also the edition of *Berte* by Gaston Paris (1832); Léon Gautier, *Les épopées françaises*, vol. iii, etc.

[1] 100,000 rupees is written as Rs. 1,00,000; 10,000,000 is written 1,00,00,000.

**ADENOIDS.** A condition, commonly found in children, produced by excessive growth of the pharyngeal tonsil or adenoid (*see* PHARYNX). The enlargement may block the nasal passages or the eustachian tube and produce disturbances in breathing and in hearing

If severe, the child may assume a characteristic vacant, stupid expression accompanied by mouth breathing. The presence of these growths may handicap the child in his physical and mental development. The removal is a relatively simple operative procedure

(F. L. A.)

**ADEODATUS,** pope and saint (?–676), became bishop of Rome on April 11, 672, and died on June 16, 676

Little is known of his life before 672 except that he was a monk in the Roman monastary of St. Erasmus, whose quarters he later helped to enlarge.

During his pontificate the Monothelite controversy (*q.v.*) over the unity or duality of Christ's will was still active between the sees of Rome and Constantinople To Adeodatus, during this controversy, was ascribed the rejection of the *Synodikon* tendered by Constantine I of Constantinople, and the repression of the Monothelite heresy.

Also ascribed to him is the work of restoring the basilica of St Peter at Campo di Merlo near Rome. Beyond these few works little else is known of his reign as pontiff. Of his writings, only letters of his to the abbeys of St. Peter of Canterbury and St Martin of Tours are extant, both relating to the granting of privileges to these churches Occasionally he is referred to as Adeodatus I being the alternative name of an earlier pope Deusdedit (*q.v.*).

**ADEPT** (if used as a substantive pronounced *ad*ept, if as an adjective a*dept;* Lat. *adeptus*, "one who has attained"), completely and fully acquainted with one's subject; an expert.

The word implies a natural inborn aptitude, more than acquired proficiency. In olden times an adept was one versed in magic, an alchemist

**ADERNÒ** (ADRANO), town of the province of Catania, Sicily, 22 mi. by rail N.W. of the town of that name Pop. (1936) 24,307 (town), 24,515 (commune). Anciently Adranon (the original Siculan settlement was perhaps about 5 mi. away), it took its name from Adranos, an indigenous deity, in Roman times identified with Vulcan, to whom was dedicated a temple guarded by 1,000 huge dogs. Substructures of the temple may persist outside the town. The town, founded by Dionysius I (*c.* 400 B.C.), has fine remains of its walls (*see* P. Orsi in *Not. Scavi*, p. 227 [1915]).

For a time it was the headquarters of Timoleon, and it was the first town taken by the Romans in the First Punic War (263 B.C.). In the centre of the modern town rises the castle built by Roger I.

**ADES,** nonalcoholic beverages made from the juice of lemons, oranges or limes, powdered sugar or syrup and plain, mineral or carbonated water. Usually a maraschino cherry and cracked ice, and a straw through which to sip the drink, are added.

Ades are sold in the United States chiefly at soda fountains and drugstores. "Orange drinks" are also served at street stands and corner shops, as are drinks made from the juice of pineapple, grapefruit, etc.

The juice of the fruit is ordinarily extracted through electrical machines installed at soda fountains.

The advantage in this method lies in the fact that the customer sees with his own eyes the fresh fruit and the resulting unadulterated juice.

**ADHAN:** *see* AZĀN.

**ADHEMAR DE CHABANNES** (*c.* 988–1034), mediaeval historian, was born at Chabannes, Fr. He was a monk of the monastery of St. Cybard, Angoulême, and died at Jerusalem.

Adhémar's principal work, *Chronicon Aquitanicum et Francicum,* or *Historia Francorum,* is in three books and deals with Frankish history from the fabulous reign of Pharamond, king of the Franks, to A.D. 1028.

The two earlier books are scarcely more than a copy of the *Gesta regum Francorum,* but the third, dealing with the period from 814 to 1028, is of considerable historical importance, and

is published in the *Monumenta Germaniae historica, Scriptores,* iv (Hanover and Berlin, 1841).

A critical edition of the entire *Chronicon,* prepared by Jules Chavanon (1897), is in the *Collection de textes pour servir à l'étude et à l'enseignement de l'histoire* Other writings of Adhémar's are published by J. P. Migne in the *Patrologia Latina,* tome cxli (Paris, 1844–55)

*See* F Arbellot, *Étude historique et littéraire sur Adémar de Chabannes* (Limoges, 1873).

**ADHEMAR** (ADEMAR, AIMAR, AELARZ) **DE MONTEIL** (d 1098), crusader, became bishop of Puy-en-Velay after the deposition of his predecessor by Gregory VII in 1077. He made a pilgrimage, possibly to Jerusalem, in 1086–87

It was from Puy that Urban II, on Aug 15, 1095, convened the council that met at Clermont in the following November; there he began the preaching of the first crusade Adhemar, the first of his audience to take the Cross, was appointed by Urban to lead the crusade as his legate

He travelled to Constantinople with Raymund IV of Toulouse and the Provençal contingent During the crossing of Asia Minor and the siege of Antioch (May 1097 to June 1098) there was no supreme commander of the crusade, but Adhemar played a leading part in the counsels and activities of its leaders He was prominent in military operations and in the situation which developed during the siege of Antioch when Peter Bartholomew claimed to have discovered the Holy Lance. He organized the mass religious devotions at times of crisis, and he began to establish friendly relations with the eastern Christians

He appears to have commanded universal respect and affection and so restrained the quarrels that arose from the conflicting ambitions of the lay leaders. This was his greatest service to the expedition.

After Adhemar's death of the plague in Antioch (Aug. 1, 1098), division within the army became so acute that the crusade almost foundered

*See* L. Bréhier, "Adhémar de Monteil," *Dictionnaire de biographie* [illegible] J Balteau *et al*, vol i, col 590–598 (Paris, 1933); also [illegible] *History of the Crusades,* vol i (Cambridge, 1951).

(R C. SMA.)

**ADHESIVE CEMENTS:** *see* CEMENT: *Adhesive Cements.*

**ADIABATIC CHANGE,** a change in the physical state of a body, whether this change be one of volume, strain, electric charge, etc., which involves no passage of heat to or from the body.

(*See* THERMODYNAMICS.)

**ADIABATIC PROCESSES IN ATMOSPHERE.** Because of the large volumes of air involved and the relatively small temperature differences between adjacent air parcels, it is common to assume that no heat is added to or withdrawn from the air (adiabatic process) during atmospheric processes.

This assumption appears to be justified for air which is not in contact with the ground and for processes which are completed in from a few hours to a day. When air ascends or descends it expands and contracts as a result of the change in pressure. If no condensation or evaporation of water occurs the air will cool about 1° C. per 100 metres rise (5.4° F. per 1,000 ft.), which is called the dry adiabatic lapse rate.

When moist air is lifted it will cool at the dry adiabatic rate (the presence of moisture has a negligible effect until saturation is reached) until it becomes saturated. Further lifting will result in the condensation of water vapour or cloud formation. The latent heat of condensation is added to the air and as a result it cools less rapidly, at the so-called moist or saturated adiabatic lapse rate.

The value of the moist adiabatic lapse rate depends on the temperature and pressure being about 0.44° C. per 100 metres at 20° C and 1,000 mb and 0.80° C. per 100 metres at −20° C. and 600 mb. If saturated air descends it follows the moist adiabatic lapse rate only as long as it contains liquid water in suspension which can evaporate; otherwise it follows the dry adiabatic lapse rate. If an air parcel of absolute temperature $T_o$ and pressure $p_o$ is dry-adiabatically compressed or expanded to a pressure $p$, its temperature T is given by $T=T_o(p/p_o)^{.286}$.

(*See* METEOROLOGY; LAPSE RATE OF TEMPERATURE, THERMODYNAMICS, UPPER AIR SOUNDINGS)

(H G HN)

**ADIAPHORISTS,** the name of a party in the religious controversies of the 16th century in Germany. The Adiaphorist controversy among Lutherans was an issue of the provisional scheme of compromise between religious parties, drawn up by Charles V, [illegible] at the Diet of Augsburg, May 1548, and known as the Augsburg Interim. It satisfied neither Catholics nor Protestants. As head of the Protestant party the young elector Maurice of Saxony negotiated with Melanchthon and others, and at Leipzig, Dec. 1548, secured their acceptance of the Interim as regards *adiaphora* (things indifferent), points neither enjoined nor forbidden in Scripture. This sanctioned jurisdiction of Roman Catholic bishops and observance of certain rites, while all were to accept justification by faith (relegating the words "by faith *alone*" to the *adiaphora*). Passionate opposition was led by Melanchthon's colleague, Matthias Flacius, on the grounds that the imperial power was not the judge of *adiaphora,* and that the measure was a trick to bring back popery. From Wittenberg he fled, April 1549, to Magdeburg, making it the headquarters of rigid [illegible]. Practically, the controversy was concluded by the religious peace ratified at Augsburg (Sept. 1555), which left princes a free choice between the rival confessions with the right to impose either on their subjects; but much bitter internal strife was kept up by Protestants on the theoretical question of *adiaphora;* to appease this was one object of the Formula Concordiae, 1577. Another *Adiaphorist* controversy between Pietists and their opponents, respecting the lawfulness of amusements, arose in 1681, when Anton Reiser (1628–86) denounced the opera as anti-Christian.

*See* J. Herzog and A. Hauck, *Realencyklopädie* (3rd ed.); and F. Hastings, *Encyclopaedia of Religion and Ethics,* art. "Adiaphorism" where the connection of this historic question with the fundamental question of what is vital or essential is shown. For an earlier study, on rigourist lines, *see* E. Schmid, *Adiaphora, wissenschaftlich u. historisch untersucht* (1809).

**ADIGE,** river, north Italy. The Adige rises in small lakes on the Resia (Reschen Scheideck) pass (4,944 ft.), and near Glorenza is joined by tributaries where roads over the Ofen and Stelvio passes fall in. It flows E. to Merano, and S.E to Bolzano, where it receives the Isarco (6 ft ), and becomes navigable. Turning S.W., and receiving the Noce (right) and the Avisio (left), it enters Lombardy, 13 mi. S. of Rovereto. It falls into the Adriatic at Porto Fossone, a few miles N. of the Po. The most considerable towns on its banks (south of Bolzano) are Trento, Rovereto, Verona and Legnago. It is very rapid, with sudden floods which do great damage. In Lombardy it is 200 yds wide, and 10 to 16 ft. deep, but the strong current impedes navigation. The Adige is 220 mi. long and, after the Po, the most important river in Italy. In Roman times its lower course lay much farther north than now, along the base of the Euganean hills, and it entered the sea at Brondolo. In A.D. 587 the river broke its banks and took its present course, but new streams opened repeatedly to the south, until now the Adige and Po form one delta.

**ADIGEI** (ADYGEI), autonomous region in the north Caucasian area of the R.S.F.S.R., created July 1922. It is a narrow strip of territory lying north and south of lat. 45° and curving south at about long. 41° E., forming an autonomous island in the north Caucasian area, mainly along the south banks of the Kuban river and Laba river, from west of Krasnodar to south of Labinsk. It was formerly part of the Kuban province. The Kuban river is navigable to its confluence with the Laba river but is malarial and swampy and frequently floods its banks. The population (1939) 241,773 is entirely rural and is administered from Krasnodar, for which purpose it is divided into the following sections:—Dzhidzhikhablsk, Natyrbovsk, Preobrazhensk, Takhtamykaevsk, Khakyrino-Khabalsk. The Adigei or Adygei (their own name) or Cherkess (their Russian name) are Circassians who formerly occupied the mountain valleys but were compelled by Russia in 1861 either to settle on the flat land or to emigrate (200,000 settled in Turkey, as the Bashi-Bazouks). They are mainly Alpine in physical type and speak a language of the

Abkhazo-Adigean group of the "Spirant" branch of the Japhetite languages Their religion was Mohammedan, mingled with old heathen and modern Christian rites. Cattle and sheep rearing were their chief occupations, and great respect to seniority and hospitality, and fierce vendettas, were characteristic Their present habitat is on the southern limit of the black-earth steppe region where it merges into the broad-leaved, deciduous forest. They are now mainly an agricultural people, with wheat, maize and sunflower seed as the chief crops; consequently, their old customs are rapidly dying out

**ADIPOCERE,** a substance into which animal matter is sometimes converted (from the Lat. *adeps,* "fat," and *cera,* "wax"), and so named by A F. Fourcroy, from its resemblance to both fat and wax. When the Cimetière des Innocens at Paris was moved in 1786–87, great masses of this substance were found where the coffins containing the dead bodies had been placed very closely together Chemically, adipocere consists principally of a mixture of palmitic, margaric and oxymargaric acids combined with a little ammonia; glycerine appears to be absent (*see* also under OILS, FATS AND WAXES)

Lime, derived from the tissues, is present with other substances as an inorganic residue It appears that it is not formed from protein, but from the body fats which collect together and undergo decomposition

**ADIPOSE TISSUE** is composed of specialized connective tissue cells which contain large globules of fat. The chief chemical constituents of this fat are the neutral glycerol esters of stearic, oleic and palmitic acids. The fat stored in these cells comes in part directly from the fats eaten, and in part is manufactured within the body from fats and carbohydrates in the food and sometimes from protein. The main reservoir of fat in the body is the adipose tissue beneath the skin, called the *panniculus adiposus.* There are also deposits of fat between the muscles, among the intestines and in their mesentery, around the heart and elsewhere.

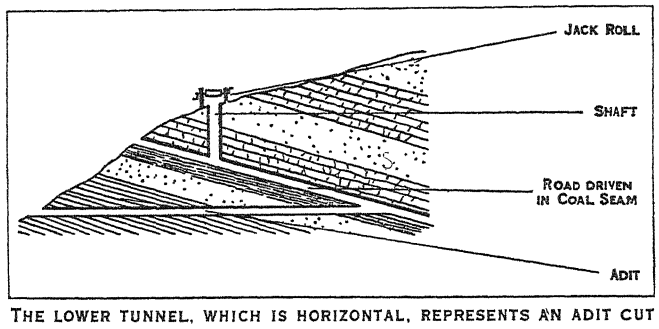
Besides acting as a fuel reserve against times of starvation or great exertion adipose tissue helps conserve the heat of the body and forms soft and elastic pads between the various organs.

**ADIRONDACKS,** a group of mountains in northeastern New York, U.S., in Clinton, Essex, Franklin and Hamilton counties, often included by geographers in the Appalachian system, but pertaining geologically to the Laurentian highlands of Canada. Unlike the Appalachians, the Adirondacks do not form a connected range, but consist of many summits, isolated or in groups, arranged with little appearance of system. There are about 100 peaks, ranging from 1,200 to more than 5,000 ft in height, and 42 more than 4,000 ft., the highest peak, Mt. Marcy (called by the Indians Tahawus, or "cloud splitter"), is near the eastern part of the group and attains an elevation of 5,344 ft. Other high peaks are McIntyre, 5,112 ft ; Skylight, 4,920; Haystack, 4,918, and Whiteface, 4,872. These mountains, consisting of various sorts of gneiss, intrusive granite and gabbro, have been formed partly by faulting but mainly by erosion, the lines of which have been determined by the presence of faults or the presence of relatively soft rocks. The mountains form the water parting between the Hudson and the St. Lawrence rivers. On the south and southwest the waters flow either directly into the Hudson, which rises in the centre of the group, or else reach it through the Mohawk. On the north and east the waters reach the St. Lawrence by way of Lakes George and Champlain, and on the west they flow directly into that stream or reach it through Lake Ontario. The most important rivers within the area are the Au Sable, Black, Oswegatchie, Grass, Raquette, Saranac and Ausable Among the larger lakes are the Upper and Lower Saranac, Big and Little Tupper, Schroon, Placid, Long, Raquette and Blue Mountain. The surface of most of the lakes lies at an elevation of more than 1,500 ft. above the sea; their shores are usually rocky and irregular, and the wild scenery within their vicinity has made them very attractive to the tourist.

The region known as the Adirondack Wilderness, or the Great North Woods, embraces between 5,000 and 6,000 sq mi of mountain, lake, plateau and forest, which for scenic grandeur is almost unequalled in any other part of the United States. Railways and highways penetrate the heart of the region and small boats ply upon the larger lakes Well-marked trails lead to the crests of the better-known peaks The mountains are easily reached from Plattsburg, Port Kent, Herkimer, Malone and Saratoga Springs. Every year thousands spend the summer months in the wilderness, where cabins, hunting lodges, villas and hotels are numerous. The resorts most frequented are in the vicinity of the Saranac and St Regis lakes and Lake Placid

In the Adirondacks are some of the best hunting and fishing grounds in the eastern U S At the head of Lake Placid stands Whiteface mountain, from whose summit one of the finest views of the Adirondacks may be obtained Two miles southeast of that lake, at North Elba, is the old farm of the abolitionist John Brown, which contains his grave and is much frequented by visitors Lake Placid is the principal source of the Ausable river, which for a part of its course flows through a rocky chasm from 100 to 175 ft deep and rarely more than 30 ft wide At the head of the Ausable chasm are the Rainbow falls Another impressive feature of the Adirondacks is Indian pass, a gorge about 11 mi long, between Mt McIntyre and Wallface mountain, a majestic cliff rising vertically from the pass to a height of 1,300 ft Keene valley, in the centre of Essex county, is another picturesque region, presenting a pleasing combination of peaceful valley and rugged hills The climate during the winter months is very severe—the temperature sometimes falling as low as —42°—it is beneficial to persons suffering from pulmonary troubles and a number of sanatoria have been established The region is heavily wooded with spruce, hemlock, pine and hardwood trees Lumbering has been much restricted by the creation of a state forest preserve, containing in 1927, 1,884,643 ac., and by the purchase of large tracts for game preserves and recreation grounds by private clubs The so-called Adirondack park, containing more than 3,000,000 ac., includes most of the state preserve and large areas held in private ownership

**ADIT.** An adit is the name given to a horizontal working made from the surface to strike a seam of coal or a mineral vein Other names for an adit are "day drift," "day hole" surf (forest of Dean), "sough" (lead mines of Derbyshire), "water-gates" (north of England), "sorre" (Yorkshire), "arndod" and "audit" as well as adit Mining by means of adits is very ancient, and was practised in hilly country where the seams were cut by valleys. It was perhaps the earliest method of mining. The adits were driven at such a level as to drain off the water from the workings. The figure shows a seam coal outcropping on the side of a hill with ventilating shaft and adit level. In modern times a number of adit tunnels were driven at much lower levels for the purpose of draining off the water in old earlier workings, in metal mines in the western part of Canada, the United States and Mexico. Inclines are sometimes called adits.




THE LOWER TUNNEL, WHICH IS HORIZONTAL, REPRESENTS AN ADIT CUT ACROSS THE STRATA, TO "WIN" AND DRAIN A COAL SEAM

Sometimes the coal was carried up the shaft on the backs of men or women climbing ladders, or by means of a jack roll worked by manual labour The coal was worked by means of narrow passages driven in the coal, small pillars being left for the support of the roof The extent to which working was possible was limited by three factors. lack of ventilation, crush of pillars and water difficulties Mechanical ventilation was not practised. A fire was placed in the shaft to heat the air and so increase the air current. The pillars were made very small with a view to getting as much coal as possible, and as the area worked extended, a point was reached at which the support offered by the pillars of coal became insufficient and a crush of the superincumbent strata supervened, inducing a "creep" or heaving-up of the floor, if the floor were a soft fireclay. If the floor was hard, a "thrust" took place and the pillars were crushed The methods of raising the water from the dip workings to the water level or adit being by means of pumps worked by manual labour, it was not possible to proceed far to the dip from beyond the point where the adit struck the seam of coal or, as it was termed, beyond "the line of free drainage."

Where the ground was flat, working by adits was not possible, so that it was usual, in very early times, to get the coal by means of bell pits (*q.v.*) sunk near the outcrop. (R. R.)

**ADJECTIVE,** a word used chiefly in its grammatical sense of limiting or defining the noun to which it refers (Lat. *ad-jacio,* "to throw to"). Grammarians used to speak of a noun and its adjective together as a noun-adjective. In the art of dyeing,

adjective colours are those which require mixing with some basis to render them permanent.

**ADJECTIVE LAW.** This term means the law of procedure and distinguishes it from the substantive law, which it is designed to enforce, the former being viewed as the machinery by means of which the latter is brought into operation

**ADJOURNMENT,** the act of postponing a meeting of any private or public body, particularly of parliament, or any business, until another time, or indefinitely (in which case it is an adjournment *sine die*). The word applies also to the period during which the meeting or business stands adjourned

**ADJUDICATION,** generally the determination of an issue by the exercise of judicial power; the entry of a decree or judgment by a court. In bankruptcy proceedings an adjudication is an order of court declaring a debtor to be bankrupt. (*See* BANKRUPTCY)

**ADJUNCT,** that which is joined on to another, not an essential part, and inferior to it in mind or function, but nevertheless amplifying or modifying it. (Lat. *ad,* "to," *jungere,* "to join.") Adverbs and adjectives are adjuncts to the words they qualify. Twelve members of the Royal Academy of Sciences in Paris are called "adjuncts"

**ADJUSTMENT (IN LAW):** *see* AVERAGE.

**ADJUSTMENT (IN PSYCHOLOGY)** is the process of behaviour by which men, and other animals as well, maintain an equilibrium between their needs and the demands and obstacles of their environments In its simplest form, a sequence of adjustment begins when some need is felt and ends when that need is satisfied. For example, a hungry dog is stimulated by his physiological state to engage in varied activities such as searching, begging and barking. When one of these responses brings him food, he eats and thereby reduces or removes the stimulus that set the activity sequence in motion. He is then adjusted to this particular need.

In general, the adjustment process involves four parts: (1) a motive or need in the form of a strong persistent stimulus; (2) the thwarting or nonfulfilment of this need; (3) varied activity, or trial-and-error behaviour, leading eventually to [illegible] some response that removes the initiating stimulus [illegible] adjustment

Some of the mo[illegible] adjustive behaviour are simple physiological needs such as hunger and thirst Certain other strong motives combine physiological elements and cultural or learned factors, as illustrated by the sex motives Of great importance in complex human adjustments are the social motives involved in interactions with other persons, including needs for security, approval, recognition, achievement, mastery and the like These motives are not inborn, but are strongly inculcated by learning processes that begin early in life To a great extent, they are determined by social standards and differ from one culture to another. Thus, typical persons in the European-American culture have a strong motivation to succeed and excel which is markedly lacking in persons who live in some so-called primitive cultures.

Two main kinds of thwarting may be distinguished—frustration and conflict A frustration is an external circumstance or an act of another person that prevents the fulfilment of an aroused motive. An adolescent may want to use the family automobile to drive to a dance, but be frustrated because the automobile is out of order or because his father forbids him to use it. A conflict is the arousal of two or more strong motives that cannot be satisfied together A youngster may want to go to a dance to feel that he belongs to a group and does what his friends do. For an adolescent in our culture, that is a strong motive. But the youth may be a clumsy dancer and sensitive to the real or imagined ridicule of his fellows. Therefore, he also has a motive to avoid the dance to escape humiliation He is in a dilemma; whether he goes or stays away he will experience distress. Psychologically, a conflict exists when the reduction of one motivating stimulus involves the increase of another, so that a new adjustment is demanded.

The psychological criterion of the solution of an adjustment is the elimination or reduction of the stimulation that was the source of the activity. In the total behaviour of a human being, however, adjustments rarely occur in isolation, but many have to be made simultaneously. Satisfactory adjustment therefore requires unified and integrated behaviour, in which all motives are reasonably satisfied with due regard to their functioning as an interrelated system.

**Substitute Adjustments.**—Adjustments to simple physiological needs such as hunger or thirst can be made only [illegible] The organism must eat and drink or it will die. Adjustments to social motivations, however, permit a variety of solutions, some of which are more direct and more satisfying than others. Suppose, for example, that a university student fails his examinations This is a situation demanding adjustment, for it thwarts not only his educational and vocational plans, but also his strong social needs for security, approval and achievement The student may adjust by finding and remedying the cause of his difficulties, by increasing his effort or by changing his plans in a rational manner, all of which are direct and constructive solutions He may also adjust by blaming others for his failure, by claiming that the examinations were unfair, by emphasizing his attainments in other than academic tasks (such as athletics), by daydreaming of imaginary successes or by developing an apparent illness that excuses his failure All of these are adjustments of a sort, for they are in some degree satisfying to the social needs for success and approval

A number of the more common varieties of substitute adjustments have been named and defined, and are usually known as adjustment mechanisms

Adjusting by overemphasizing a trait in order to conceal a weakness is known as *compensation* Thus, a boy who fears his own lack of strength in competition with his equals may adjust by becoming a bully of younger children; a man sensitive to his own lack of education may affect the use of long words; or an unattractive girl may call attention to her intellectual or vocational accomplishments Compensations are somewhat satisfying because they are rather close substitutes for the thwarted achievement, and because they divert attention from the deficiency that the person feels The mechanism of *rationalization* is somewhat similar. In rationalizing, the individual convinces himself, and attempts to convince others, that there are socially acceptable reasons for conduct that is determined by quite different motives Selfishly based behaviour is defended as socially acceptable, or as no worse than that of other persons.

In *projection,* individuals attribute to others the traits and motives that are the subject of their own conflicts The student resisting a strong temptation to cheat may be unusually sensitive to this evil and think that he sees dishonesty in many acts of others. Rationalization and projection are the psychological bases of delusions found in some persons suffering from severe mental disorders Blaming their failures on others gives rise to delusions of persecution, while delusions of grandeur serve to support a sense of importance and to explain why they were selected for persecution

In other instances, persons will adjust to social difficulties by withdrawing from contacts with other people and developing phantasies of [illegible] achievements. The mechanism of *regression* consists of learning to forget or ignore distressing thoughts, [illegible] in both mild and serious maladjustments. It is illustrated by the "blind spots" that normal people have with respect to their own shortcomings and, at the extreme, by the almost complete forgetting of a person's past life which may be his reaction to catastrophic conflicts. *Regression* is a reversion to an adjustment [illegible] earlier period of life, as when an older child competes for the attention of his parents by reverting to infantile [illegible] may also adjust by becoming ill, which excuses their failures and permits them to escape from unbearable situations Illnesses as adjustments are mainly examples of *hysterical* mechanisms which, like most other types, vary greatly in severity The reluctant schoolchild's nine-o'clock headache expresses his distaste for academic tasks; a soldier's paralyzed arm may resolve the conflict between his pride and his guilt or fear

If a person with serious frustrations or conflicts cannot find a reasonably satisfactory direct or substitute solution, he remains in a nonadjustive state He is activated by motivating stimuli that he cannot reduce, and therefore is tense, overactive and susceptible to emotional reactions. Common evidences of nonadjustment are anxiety, worry and so-called "nervousness."

It must be emphasized that substitute adjustments are usually unconscious in the descriptive sense of this term. The person who employs them does not deliberately attempt to deceive others. Instead, he hits upon a type of behaviour that reduces his motivations and gives him a vague sense of relief from tension He does not understand the source or meaning of his reactions, and often is anxious to improve his adjustments but does not know how to do so.

Substitute adjustment mechanisms are used by all people and are not abnormalities in themselves. The difference between quite normal people who display many of these mechanisms, and people who are severely maladjusted or psychoneurotic, is one of degree rather than of kind of behaviour.

**Readjustment.**—Persons who suffer from difficulties of psychological adjustment can be helped by psychotherapy, a process of treatment carried out by psychiatrists, clinical psychologists or psychiatric social workers, or by clinics in which these qualified specialists work as a team. They recognize that advice, persuasion or punishment are not effective means for accomplishing readjustment.

Psychotherapy is a series of conferences between the therapist and the client. The therapist listens to the client's story, accepts his motivations, conflicts and inadequate behaviour without reproach or praise, and makes responses that acknowledge and clarify the client's attitudes and feelings. In the permissive and supportive atmosphere provided by the therapist, the client becomes able to recall and to piece together significant aspects of his past experiences and present attitudes that hitherto he was unable to face. The client learns, at his own pace and through his own thinking, to react to his conflicts more calmly and constructively. Improvement in his everyday behaviour may follow. (*See* PSYCHOTHERAPY; PSYCHOLOGY)

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(L F SR)

**ADJUTANT,** a helper, or junior in command, one who assists his superior, especially an officer who acts as an assistant to the officer commanding a battalion or unit of similar scale. In the British army the appointment of adjutant is usually held by a captain or lieutenant The adjutant acts as staff officer to the commanding officer, issues his orders, superintends the work of the orderly room and the general administration of the corps and is responsible for the training of recruits. Regular officers are appointed as adjutants to units of the territorial army. In the French army, however, the title is given to senior underofficers of superior grade to sergeant. On the European continent the word is not restricted to the lower units of organization; for example, in Germany the *Adjutantur* includes all "routine" as distinct from "general" staff officers in the higher units, and the aides-de-camp of royal persons and of the higher commanders are also styled adjutants general, *Flügel-adjutanten,* etc.

**ADJUTANT BIRD,** the name given to large storks (*q.v.*), of the genus *Leptoptilos,* distinguished by their dull plumage, black scabrous head and enormous pouch, of doubtful function, connected with the respiratory system The largest is *L dubius* of India. It feeds on offal, frogs and fish, and is a most efficient scavenger, for which reason it is usually protected. Other species are *L. javanicus* of southeast Asia and *L. crumeniferus,* the marabou stork of Africa; the "marabou" feathers of commerce were originally the undertail coverts of this bird, but the name is now applied to a large number of kinds of downy feathers.

**ADJUTANT GENERAL,** an army official, originally (as indicated by the word) the chief assistant (Lat. *adjuvare*) staff officer to a general in command, but now a distinct high functionary at the head of a special office in the British and U.S. war departments. In England the second military member of the army council is styled adjutant general to the forces. He is a general officer and at the head of his department of the war office, which is charged with all duties relative to personnel. The adjutant general of the U.S. army is one of the principal officers in the war department, the head of the bureau for army correspondence, with the charge of the records, recruiting, issue of commissions, etc Individual U.S. states also have their own adjutant general, with cognate duties regarding the state militia. In many countries the term has retained its original meaning of an officer on the personal staff, and is the designation of personal aides-de-camp to the sovereign.

**ADLER, FELIX** (1851–1933), U.S. educationalist, was born at Alzey, Ger., Aug. 13, 1851. His father, a Jewish rabbi, emigrated to the United States in 1857, and the son graduated at Columbia college in 1870. After completing his studies at Berlin and Heidelberg, he became professor of Hebrew and oriental literature at Cornell university, Ithaca, N.Y. (1874–1876). In 1876 he established in New York city the Society for Ethical Culture. In 1902 he became professor of political and social ethics at Columbia university. Adler took a prominent part in philanthropic and social reform movements, such as the erection of model tenement houses and the abolition of child labour. He published *Creed and Deed* (1877), *The Moral Instruction of Children* (1892), *Marriage and Divorce* (1905), *The Religion of Duty* (1905), *The World Crisis and Its Meaning* (1915), *An Ethical Philosophy of Life* (1918) and *The Reconstruction of the Spiritual Ideal* (Hibbert lectures at Oxford, 1923). He died April 24, 1933.

**ADLER, HERMANN** (1839–1911), British chief rabbi, born at Hanover, Ger., on May 30, 1839, the son of N. M. Adler, was educated at University College school and University college, London, and then at Prague under Rapoport. After receiving the rabbinical diploma at Prague, he returned to England to become temporary principal of the Jewish Theological college in London for two years. With this college he was associated in one capacity or another all his life. He began his ministry at the Bayswater synagogue in 1864, and continued to preach there until 1891, when he became chief rabbi on the death of his father. Adler was a prominent figure in English public life, and served on many Mansion House committees and on various bodies concerned with the improvement of social conditions in London He died on July 18, 1911 A collection of his sermons, entitled *Anglo-Jewish Memories and Other Sermons,* was published in 1909

His daughter, NETTY, sat on the London county council for Central Hackney from 1910–25 and was deputy chairman of the council in 1922–23. She served on many committees in connection with social questions, but her principal work was done in education. She began her social work as a school manager under the local school board, was then co-opted a member of the London education committee 1905–10, and in the county council was closely connected with the administration of the schools Apart from education, she was interested in the welfare of children from all points of view, having been for many years joint honorary secretary on the committee for the protection of wage-earning children, and a member of the London Advisory Council for Juvenile Employment

**ADLER, NATHAN MARCUS** (1803–1890), British chief rabbi, was born at Hanover, Ger., Jan. 15, 1803, and died at Brighton, Eng., on Jan. 21, 1890. He took his degree of Ph.D at Erlangen in 1828. He was ordained in the same year, was chief rabbi of Oldenburg (1829) and of Hanover in 1830, and on Oct. 13, 1844, was elected chief rabbi in London. There he originated and carried out his scheme for a Jews' college for the training of teachers, which was founded in London on Nov 11, 1855, with himself as its first president. In 1860 Adler suggested the establishment of a United Synagogue which should bring all the British congregations under one central administration; this idea was realized in 1870, when the United Synagogue bill was passed in parliament. Adler's writings include sermons and commentaries on Hebrew texts, the best known of which is *Nethinah la-ger,* a commentary on the Aramaic paraphrase of Onkelos on the Pentateuch (1874).

**ADLER, VIKTOR** (1852–1918), Austrian politician, was born at Prague, June 24, 1852. He began to occupy himself early with political and social questions. In 1883 he went to study in Switzerland and in London, where he came into close touch with F. Engels. On his return to Vienna, however, he turned entirely to politics. The Workmen's party had sunk into political insignificance and Adler's task was to restore unity in the ranks of labour. In 1886 appeared his paper *Gleichheit,* eventually succeeded by *Die* [illegible] principal organ of the Social Democratic party, which Adler continued to conduct till his death. In July 1889 he appeared at the first congress of the Second International, of which he became an official, as the representative of the united Austrian Labour party. From that time he was the acknowledged leader of the party

Adler regarded it as his first task to secure for the workers representation in parliament, but it was not until 1907 that he was able to secure universal and equal suffrage The Social Democratic party increased their representation from 11 deputies to 87. [illegible] entered the di[illegible] in 1902, and in 1905 was elected to the *reichsrat,* where, until his death, he played an important part.

In the congress and in the secretariat of the International, Adler, with A Jaurès and A. Bebel, played the most prominent part, whether as leader, adviser or mediator. After the collapse of Austria in 1918 at the constituent session of the provisional German-Austrian national assembly, he read the declaration of the Social Democrats, in which they expressed their willingness in association with the other German-Austrian parties, to build the new state on the basis of democracy and self-determination, without prejudice to a possible association with the German empire He held for a few days the office of foreign minister, but he broke down and died Nov. 12, 1918, the day on which the state council had decided to proclaim German Austria a democratic republic, and an integral part of [illegible] reich.

BIBLIOGRAPHY.—His works include articles scattered in various newspapers, in the *Neue Zeit; Kampf; Deutsche Worte* (Vienna), in addition to those in the *Arbeiterzeitung;* pamphlets, among which are *Die Fabrikinspektion, insbesondere in England und der Schweiz* (1884); *Die Arbeiterkammern und die Arbeiter* (1886); *Die Gleichheit vor dem Ausnahmegericht* (1889); *Das allgemeine, gleiche und direkte Wahlrecht und das Wahlunrecht in Oesterreich* (1893); *Schwurgerichtsprozess gegen Doktor Viktor Adler wegen Verbrechens der Störung der öffentlichen Ruhe* (1894); *Alcoholismus und Gewerkschaft* (many editions) (1907).

**AD LIBITUM** (Lat., "at pleasure"), in music, a direction signifying that the performance of the passage in question is left to the unfettered discretion of the performer; also that a given portion of a composition, such as the accompaniment of a choral piece, may be omitted if desired.

**ADMETUS,** in Greek legend, son of Pheres, king of Pherae,

in Thessaly. By the aid of Apollo, who served him as a slave—either as a punishment for having slain the Cyclopes, or out of affection for his mortal master—he won the hand of Alcestis, the most beautiful of the daughters of Pelias, king of Iolcus. Finding that Admetus was soon to die, Apollo persuaded the Fates to prolong his life, provided any one could be found to die in his place. His parents refused, but Alcestis consented. She was rescued by Heracles, who wrestled with Death and made him give her back.

BIBLIOGRAPHY.—*See* A Lesky, *Alkestis: der Mythus und das Drama* (Vienna, 1925); W. Roscher's *Lexikon,* arts. Admetos, Alkestis.

**ADMINISTRATION,** the performance or management of affairs, a term specifically used in law for the administration or disposal of the estate of a deceased person. (*See* WILL or TESTAMENT.) It is also used generally for "government," and specifically for "the government" or the executive ministry, and in such connections as the administration (administering or tendering) of the sacraments, justice, oaths, medicines, etc.

**Letters of Administration.**—Upon the death of a person intestate or leaving a will to which no executors are appointed, or when the executors appointed by the will cannot or will not act, the probate division of the high court is obliged to appoint an administrator who performs the duties of an executor. This is done by the court granting letters of administration to the person entitled. Grants of administration may be either general or limited. A general grant is made where the deceased has died intestate. Formerly, on the death of the owner of realty and personalty intestate, the realty vested in the deceased's heir and the personalty in the court of probate until administrators were appointed. Now, since the rights of heirs as such are abolished by the Administration of Estates Act 1925, all the property, real and personal, vests in the court. Moreover, formerly the right to be appointed administrator was more or less defined Now by the same act the court is given an absolute discretion as to whom it shall appoint, subject to these limitations: that where there is no special reason to the contrary some person interested in the residuary estate should be appointed, and that where the estate passing on the deceased's death includes land settled otherwise than by his will the trustees of the settlement should be appointed (s. 10). Not more than four persons are to be appointed administrators (Judicature Act 1925, s. 160); and separate administrators may be appointed to the real and to the personal estate of the deceased (Administration of Estates Act 1925, s. 13). In the absence of statutory next-of-kin the crown, on the death intestate of an owner of land and personalty, is now entitled to both as *bona vacantia,* escheat both to the intermediate lord and to the crown being abolished. If a creditor claims and obtains a grant he is compelled by the court to enter into a bond with two sureties that he will not prefer his own debt to those of other creditors.

The more important cases of grants of special letters of administration are the following:—

Administration *cum testamento annexo,* where the deceased has left a will but has appointed no executor, or the executor appointed has died or refuses to act. In this case the court will make the grant to the person with the largest beneficial interest.

Administration *de bonis non administratis:* this occurs in two cases: (1) where the executor dies intestate after probate without having completely administered the estate; (2) where an administrator dies. In the first case the principle of administration *cum testamento* is followed, in the second that of general grants in the selection of the person to whom letters are granted.

Administration *durante minore aetate,* when the person nominated by the will as executor is under age.

Administration *pendente lite,* where there is a dispute as to the person entitled to probate or a general grant of letters the court appoints an administrator till the question has been decided.

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**ADMINISTRATIVE COMMISSION** is the name applied in the United States to a governmental agency headed by a group of persons rather than by an individual and charged with the enforcement or execution of a law or laws. In Great Britain such agencies are more often known as administrative boards, such as the Local Government board (1871–1919); however, the civil service commission (1855– ) offers an example of a different practice in nomenclature. There also have been numerous royal commissions consisting of prominent citizens designated by the government of the day to study troublesome public questions and offer suggestions for needed legislation. These bodies, however do not have administrative functions.

In the United States, administrative commissions first appear among national governmental agencies with the creation of the civil service commission under the Pendleton act of 1883 This was followed, in 1887, by the Interstate Commerce commission in 1914 by the Federal Trade commission, in 1916 by the United States tariff commission and the United States employees' compensation commission, in 1920 by the Federal Power commission in 1934 by the Federal Communications commission and the Securities and Exchange commission, and in 1936 by the United States Maritime commission which, in turn, was successor to the United States Shipping board, created in 1916. While the name commission is the most common among such administrative agencies in the national government of the United States, it is not universal. Functions similar to those performed by the agencies just enumerated are entrusted to the [illegible] board, created in 1934 to take the place of the earlier United States Board of Mediation (1926–34), the Railroad Retirement board (1935– ), and the National Labor Relations board (1935– ).

It is necessary, in the United States as well as in Great Britain, to distinguish between administrative commissions and government corporations. Examples of the latter include, in Great Britain, the British Broadcasting corporation and in the United States, the Tennessee Valley authority. While such agencies normally have plural heads and are charged with governmental administrative functions, their legal status differs from that of the administrative commission. They are usually provided with capital by the government, but are free to operate within the scope of their charters without bureaucratic intervention in administrative details. Ex-officio and advisory bodies are not properly included among administrative commissions, since they have no continuing responsibility for the execution of law.

Administrative commissions in the United States vary in size from 3 to 11. They are appointed by the president with the advice and consent of the senate, but they are not represented in the president's cabinet. In most cases the law establishing the agency provides that no more than a simple majority of the members may belong to the same political party.

Such agencies are found not only in the national government of the United States, but also in the several state governments and occasionally in city government. The most common state agencies of this type include industrial commissions, boards of health, boards of education, boards of public welfare and unemployment compensation commissions. In local government they appear mainly in the fields of health and education.

Administrative commissions are commonly used where quasi-legislative and quasi-judicial as well as executive functions are to be discharged. Thus these agencies offer a means of escape from a rigorous application of the separation of powers doctrine in government. Legislators, in establishing new commissions, show an increasing tendency to delegate to them broad powers of subordinate legislation. Judges and lawyers deprecate the tendency to confide judicial powers to administrative tribunals, but the expense and delay of proceedings in the regular courts make supplementation inevitable. While boards are not as well suited to the performance of administrative duties as are single-headed departments, they do provide continuity of policy through long overlapping terms of office, insulate the execution of the law from partisan political interference and permit the representation of interest groups concerned with the administration of legislation.

*See* Frederick F. Blachly and Miriam E. Oatman, *Administrative Legislation and Adjudication* (1934); Avery Leiserson, *Administrative Regulation* (1942); Walter Gellhorn, *Federal Administrative Proceed-*

*ings* (1941); Joseph P. Chamberlain, Noel T. Dowling, Paul R. Hays, *The Judicial Function in Federal Administrative Agencies* (1942), Robert E. Cushman, *The Independent Regulatory Commissions* (1941). (HA. W.)

**ADMINISTRATIVE LAW.** Administrative law consists of all those principles and rules of law which together furnish the legal matrix of public administration. This description, it will be noted, differentiates administrative law from the rest of the law solely in terms of its subject matter. Indeed, in Anglo-American jurisprudence there exists no separate body of law which deals with this subject matter. Instead, the pertinent principles and rules find their sources scattered through constitutions, statutes, judicial decisions, and even administrative regulations and orders. The factor, however, which gives them a significant unity is their common bearing upon the organization and functioning of the administrative authorities of the modern state (*see* AUTHORITY, ADMINISTRATIVE).

**Scope of Administrative Law.**—It follows from the definition of administrative law that its scope corresponds exactly with that of public administration. The administrative system exists primarily to render public services and exercise public controls of persons or property. To this end the law must establish appropriate administrative agencies, vest in them certain powers, prescribe the scope and limits of such powers, provide means of enforcing the administrative decisions made in the exercise of such powers, and furnish the private parties who may be affected with remedies or safeguards against administrative action which is arbitrary, discriminatory or unauthorized.

Of the powers delegated to administrative authorities by modern regulatory statutes, four types may be mentioned: (1) the *rule-making power,* or the power to issue general rules and regulations having the force of law for the purpose of filling up the details of statutory policy; (2) the *licensing power,* or the power to grant or refuse, to renew, and to revoke licences or permits which may be required by statute for the pursuit of [illegible] as law and medicine and the conduct of certain forms of business; (3) the *investigatory power,* or the power to require witnesses to testify and produce books, papers and records for the purpose of acquiring the information needed for effective regulation; and (4) the *directing power,* or the power to issue, usually after notice and an opportunity to be heard, administrative orders by which the private party is required, in conformity with the governing statute, to do or refrain from doing specified things.

Whatever the public service and control functions of the administrative system may be, however, their performance depends upon its also conducting auxiliary operations which relate to its organization as a going concern, provision for its personnel and [illegible] the financing, planning and over-all administrative management of its varied activities. Accordingly, the law must also establish rules to authorize and govern these auxiliary and managerial operations and the relations which the administrative system is to bear with respect to them to other parts of the government.

In the United States early efforts at systematic treatment of these aspects of the law consisted mainly of bringing together the pertinent principles of judge-made law under the heading, "the law of public officers." Around the turn of the century, however, Frank Johnson Goodnow made, against the background of the systems of continental Europe, the first comprehensive study of U. S. "administrative law" conceived as the legal framework of public administration. In this new perspective many common law principles considered under the older heading found their appropriate place.

**Purposes of Administrative Law.**—Only by bringing together from all sources the relevant legal principles is it possible to acquire that over-all view of the legal mould of public administration which clarifies its purposes and gives intelligent guidance to its development. In the broadest sense, the problem of administrative law is an aspect of the central problem of political theory: the reconciliation of authority and liberty. More specifically, the purposes of legal control of public administration are: (1) to establish administrative authorities and enable them to carry out public policies designed to protect the public interest, and (2) to safeguard private interests against administrative arbitrariness or excess of power.

It is important to remember, however, that in the larger view each of these interests includes the other as a factor. The public interest includes the welfare of all members of the community, those who are regulated no less than those for whose protection regulation is undertaken. Accordingly, the public interest itself suffers if those who are regulated become victims of administrative oppression. Yet it is equally true that the private interest of those who are regulated includes in the long run the public interest. They may profit in the short run if the law renders ineffective administrative efforts to prevent their exploitation of the public; but by the same token it may render ineffective their protection against forms of exploitation indulged in by others. The aim of administrative law is thus to attain a synthesis of public and private interests in terms of the social and economic circumstances and ideals of the age.

**Droit Administratif versus the Rule of Law.**—Some form of judicial control of administrative action is so necessary to the protection of private interests against administrative abuse as to have come in the western world to be considered a characteristic feature of free government. In broad outline, however, this judicial control has for historical reasons taken two different forms, the continental European and the Anglo-American.

Of the former the French system of *droit administratif* is perhaps typical. That system provides for a high degree of administrative centralization, and exempts the administrative authorities from control by the ordinary tribunals. This does not mean, however, that these authorities are free from all forms of judicial control. For in France there are two separate systems of courts, the ordinary and the administrative. The former try cases under the civil and criminal codes, while the latter try cases involving official action. The highest administrative court, the judicial branch of the council of state, has developed a body of case law which has given satisfaction at home and received high praise from many foreign observers.

In England, on the other hand, there developed a decentralized administrative system, with central control exercised by the king's judges as a part of their common law jurisdiction. In the long struggle with the Stuarts the foundations of the modern system were completed. Chief Justice Sir Edward Coke exalted the common law as a sort of embodiment of natural justice and symbolized its supremacy as against the high prerogative claims of James I. The long parliament abolished the star chamber and other extraordinary courts, which had threatened to become engines of Stuart tyranny. The "Glorious Revolution of 1688" marked the final establishment of the legislative supremacy of parliament; and the Act of Settlement gave the judges tenure during good behaviour. Thereafter, even the servants of the crown were amenable to the ordinary law of the land, which meant the law administered by the independent judges of the common law and chancery courts on the basis of judicial precedents or acts of a sovereign parliament.

From the beginning of the 18th century, therefore, there has been in England and in every country which derived its jurisprudence from [illegible] but a single hierarchy of courts, the ordinary judicial tribunals, which hear cases involving official action as an incident of their common law or statutory jurisdiction, and which apply to such cases no separate body of law, but the law of the land in the form of the common law, equity, statutes and (where they exist) written constitutions. Under the name of the "rule of law" this system was idealized in 1885 by A. V. Dicey in his *Law of the Constitution;* and in countries in which the rule of law in this special sense prevails, administrative law is an appropriate name for those general and special principles and remedies of the law of the land by which the ordinary courts control administrative action.

Those accustomed to one of these two systems run the risk of judging the other in terms of their own. The basis of a practical comparison would be topic by topic in terms of attainment of the purposes of administrative law. Dicey's volume became a classic

of English-speaking legal literature; but his comparison of the rule of law with *droit administratif* has been subjected to searching criticism. He described the rule of law, for example, as excluding the existence of "wide discretionary authority on the part of the government"; but the growth in England of administrative discretion caused even Dicey to admit in his eighth edition of 1920 that this development had "some features which faintly recall" French administrative law.

Dicey further declared that the rule of law means the "equal subjection" of official and citizen to "the ordinary law of the land administered by the ordinary Law Courts"; but what matters in practice is not whether there are two bodies of law and two kinds of courts or only one, but whether the balance struck between public and private interest is comparable under the two systems. Even the common law treats cases involving official action differently in some instances from those in which this factor is absent; and if the injured citizen may hold the government responsible in place of the officer, it is certainly not obvious that there is any practical virtue in holding the officer personally responsible merely in order to subject him to the same law that governs the citizen. The peculiar virtue which the rule of law possesses in this respect is that it symbolizes the Anglo-American distaste for the idea that officialdom is a class apart, to which special deference is due The subtlety of this virtue, however, goes beyond all practical considerations.

French administrative litigation is far less expensive and burdened with technicalities than that in U.S. courts. Though the members of the judicial branch of the French council of state do not have formal independence of the administration, of which they are technically a part, it is said that they enjoy practical independence. The fact that they bring to their task either administrative experience or training in administrative law or both might even tend to make their judgment more balanced than that of judges trained only in the common law and private practice.

Whatever the respective merits, however, of these two great systems, the French and the Anglo-American, each is so deeply rooted in historical experience and tradition that, though they may still further approach each other in results, this is likely to take place [illegible] modification rather than wholesale importation.

**The Extraordinary Remedies.**—In England, judicial control of administrative action was first systematically worked out through use of the prerogative writs. These ancient writs were originally granted only to the king for the control of local officers, but in time came to be available to private parties as against the central administration, and still play an important part in the administrative jurisprudence of both Great Britain and the U S In the latter country they are known as the extraordinary remedies. Five of them are products of the common law, while the sixth, the injunction, is a product of equity. Since an understanding of their nature is a first step in the study of Anglo-American administrative law, they will be briefly described in turn.

*Quo warranto* may be used to try the legal title of one assuming to exercise a public office. At common law the action may be brought only in the name of the state by the attorney general, who may proceed *ex officio* or on the petition of another. The latter is known as the relator, while the one whose title to the office is to be tried is known as the respondent. It is no defense for the respondent to show that he is the officer *de facto;* if he fails to show that he is presently the officer *de jure,* the state is entitled to judgment of ouster. This involves removal of the respondent; and thereafter all pretended official acts done by him are void for all purposes. If the relator claims to be the lawful officer, the court may incidentally pass upon his claim of title.

By the writ of *mandamus* the court orders a public officer to perform a particular nondiscretionary act which it is his legal duty to perform and the legal right of the petitioner to have performed. The writ is issued only if there is no other adequate remedy. It is not used to control official discretion, but it may order an officer to exercise a discretion which it is his legal duty to exercise. It is also used in effect to correct gross abuse of discretion, as when the officer admits facts which show that his only reason for noncompliance is an arbitrary one. The writ is not available to compel a general course of action in law enforcement; for this would make the court in effect the supervisor of an executive function.

Described as the strong arm of equity, the *injunction* is issued by a court exercising equitable jurisdiction to compel the defendant, who may be a public officer, to do or refrain from doing a particular thing. If the writ orders him to do something, it is called a mandatory injunction; while if it orders him to refrain from doing something, it is called a preventive injunction The latter is the more usual form, and is sought by one party against threatened infringement of his rights at the hands of another. The court may issue a temporary or interlocutory injunction to preserve the *status quo* until a full hearing can be had The permanent injunction is the final order of the court It is to be granted only if there is no adequate remedy at law; that is, only if the threatened injury could not be adequately redressed by money damages. In U.S. administrative law, however, injunctions have been so freely granted as to give rise to severe criticism An injunction against a public officer to restrain him from proceeding under an unconstitutional statute or in excess of his statutory authority is not considered a suit against the government, and hence does not require statutory consent.

By the writ of *certiorari* the court may order up from a lower court or administrative agency the record of proceedings of a judicial nature for the purpose of quashing or affirming the same An early U.S view that the scope of judicial review on common law certiorari is confined to the correction of jurisdictional errors was later shown to have been based upon a misconception of the English cases. The New York court of appeals long ago abandoned this view, and held that this writ was available, not indeed to reweigh the evidence, but to correct errors of law and to examine the case upon the whole of the evidence in order to determine whether, as a matter of law, there was any evidence which could warrant the decision. On the other hand, since in the federal courts injunction furnishes an adequate remedy, certiorari plays no important part in federal administrative law.

The writ of *habeas corpus* has well been described as the palladium of personal liberty. Upon proper application it is directed to the party, be he a private person or a public officer, who is exercising restraint upon the personal liberty of another, and orders him to produce the body of the person detained and show legal cause for the detention Upon his return to the writ a summary hearing is held. If legal cause or justification is shown, the body is remanded to the custody of the officer or other party. Otherwise, the court or judge will discharge the prisoner. The writ is available against administrative authorities in quarantine, extradition, and alien cases, and to test the jurisdiction of the military authorities over one who denies such jurisdiction.

The writ of *prohibition* runs to an inferior court or other tribunal exercising judicial power to restrain it from proceeding in excess of its jurisdiction. It is not issued when there is an adequate remedy by appeal. If the inferior tribunal is found to be exceeding its jurisdiction, judgment involves prohibiting it from entertaining any further proceedings in the matter. In U.S. administrative law the utility of the writ is restricted by the fact that it may be denied to the petitioner on the ground that the licensing or other administrative agency is exercising administrative rather than judicial power.

**The Scope of Judicial Control.**—The scope of judicial control of administrative action depends upon such variable factors as the nature of the governmental function involved, the type of administrative power which is being exercised, the wording of the particular statute in question, and the technical features of the form of relief which may be available in the courts. U.S. courts have worked out certain general principles governing the extent to which they will, in reviewing administrative determinations, regard them as conclusive or as liable to reversal; but

these principles are subject to qualification in diverse types of situation. The courts tend to require that all available and adequate administrative remedies, such as appeal from an inferior to a superior administrative officer, be exhausted before resort may be had to judicial relief; and they do not ordinarily interfere with administrative discretion. They regularly re-examine administrative determinations of questions of law, but give great weight to the interpretations of statutes made by those charged with their administration, and in case of doubt accept them as binding. Findings of fact, if supported by substantial evidence, are ordinarily accepted as conclusive; but this is a controversial subject, with a division of opinion between those who emphasize the importance of protecting private interests and those who emphasize the importance of strengthening administrative effectiveness in the public interest

**Notice and Hearing.**—Another safeguard of private interest is notice and hearing as a part of administrative adjudication. For the administrative exercise of so-called quasi-judicial powers, or those which are regarded as analogous in character to judicial power as exercised by the courts, *audi alteram partem* (that the other side be heard) is a requirement of the common law. In the U.S. notice and an opportunity to be heard are in such cases generally a requirement also of constitutional due process of law. While administrative tribunals are not bound in such hearings by all the technical rules of evidence which prevail in judicial trials, they are held to deny due process of law if they fail to apply "the rudimentary requirements of fair play."

In the making of administrative rules and regulations, an analogous safeguard is prior consultation of the private groups concerned. This is not constitutionally necessary; but good practice calls for informal consultation, and the governing statute may make formal consultation a prerequisite of issuance.

**The Enforcement of Administrative Decisions.**—Further protection of private interests is afforded by the fact that, in the U S , due process of law generally requires that, for the enforcement of administrative decisions, resort must be had to the courts. In this connection mention may be made of some of the more common means of enforcement which are provided by modern regulatory statutes. The statute may make it a misdemeanor to violate administrative rules and regulations or administrative orders or to practise a profession without a licence. It may specify a statutory appeal to court, by the administrative authority concerned, for judicial enforcement of its order which has been disobeyed. It may provide that an administrative order become final if no appeal is taken by the private party affected within a specified time, and that violation thereafter subjects the offender to a civil penalty recoverable by governmental suit in the proper court. In each of these illustrations judicial enforcement is preceded by an opportunity for judicial review to determine the validity of the administrative decision.

In an exceptional class of situations, however, due process of law is not violated by authorizing administrative authorities to execute their own decisions. An example of common law origin is summary abatement of public nuisances which endanger the public health or safety. The property of a delinquent taxpayer may also be summarily seized and sold for satisfaction of the tax. There are even some examples of administratively imposed fines. It is to be noted, however, that even summary action is subject to some form and degree of later judicial review.

**Government Liability in Tort.**—In an important class of cases the French *droit administratif* gives the private citizen more effective remedies than are furnished by Anglo-American administrative law. This is in cases in which private parties are wrongfully injured by official action. In considering such injuries French jurisprudence distinguishes between those caused by fault of service (*faute de service*) and those caused by the personal fault (*faute personelle*) of the official. For his personal faults the French functionary is liable before the ordinary courts; but for faults of service the council of state holds the government itself liable. Indeed, by holding the government responsible for damages in situations where there was in fact no fault of either sort, the council of state has seemed to some observers to be approaching something like a doctrine of risk liability by which the state insures the citizen against all exceptional injuries caused by the functioning of the public services.

In Anglo-American law wrongs other than breaches of contract are called torts. But in England the doctrine that the king can do no wrong relieves the crown, or in other words the government, of legal responsibility for torts committed by its servants and places that responsibility solely upon those servants personally, though the government may see fit to come to their relief In the U S. the national and state governments are not amenable to suit without their consent given by statute; though municipal corporations are held liable for the torts committed by their agents in connection with their proprietary or business as distinguished from their strictly governmental functions. While congress, for example, has given its general consent for the national government to be sued on its contracts, it has not done so in cases involving torts. It has, however, given governmental corporations like the Reconstruction Finance corporation the general capacity to sue and be sued.

Now this personal liability of the officer is often unsatisfactory for the officer himself, for the injured party and for the public interest. This may be seen from cases in which it has been held by U.S. courts that, if the owner cannot get a hearing before his property is summarily destroyed for the protection of the public health, he is entitled to his hearing afterward in a tort action against the officer. In such a situation, the officer may be held personally liable for money damages if a jury disagrees with his determination that a horse now destroyed had [illegible] and hence constituted a public nuisance. The owner may get a personal judgment against the officer, only to find that he has nothing with which to pay it. The knowledge on the part of the officer that he may be held personally responsible if a jury of 12 laymen later disagrees with his expert judgment may cause him to hesitate to act at his own peril in the public interest.

The inadequacies of such a solution become increasingly evident as the operations of modern government are expanded. For the public interest demands on the one hand that these operations be effectively carried out, while on the other hand their expansion enhances the likelihood of their causing injury to the private citizen. At the same time, however, faults of service are after all faults of officials; and it is not sufficient to give the citizen an effective remedy against the government if, by relieving officials of personal liability, the responsibility with which they act is so dulled as to produce an increase of avoidable injuries and an unnecessary burden upon the public treasury.

**Problems Resulting from the 20th Century Growth of Administrative Authority.**—In the first half of the 20th century both England and the U.S. witnessed a broadening of governmental functions and a corresponding growth of administrative authority. Parliament, congress, and state legislatures vested more and more powers of a quasi-legislative and quasi-judicial nature in administrative agencies. This development was a direct and inevitable result of the economic and social changes wrought by the industrial-technological revolution which swept over the western world. At the same time, however, it posed new problems in administrative law. In broad terms, these problems centre around the question: how shall this new "administrative justice" be reconciled with the traditional "rule of law?"

The growth of administrative discretion, inconsistent as it is with the traditional conception of the rule of law, seems to be a permanent feature of modern government. In terms of the rule of law, then, the crucial question is the extent to which this administrative discretion is subject to control by the courts. Otherwise, the problem shifts to that of providing an administrative personnel and administrative procedures which will tend to cause this discretion to be exercised with fairness.

*Controversy and Appraisal.*—This growth of administrative justice has been the object of vigorous attack in both England and the U.S. In the former, criticism was brought to a head by the publication in 1929 of Lord Hewart's *The New Despotism.* In his opinion the situation in England was characterized by

"administrative lawlessness" rather than "administrative law." For him the new despot was the bureaucratic despot. In consequence of this denunciation, the lord high chancellor appointed a committee on ministers' powers, whose *Report* in 1932 took a middle view. It regarded quasi-legislative and quasi-judicial powers as inevitable, but proposed various limits and safeguards.

This report also mentioned a subject which is much discussed in the U.S., when it declared (p. 78) that "bias from strong and sincere conviction as to public policy may operate as a more serious disqualification than pecuniary interest." In the U.S. various regulatory boards and commissions initiate complaints of violation of legal standards and then hear their own complaints and render decision. Critics say that this arrangement makes the agency both prosecutor and judge and gives it such an interest in deciding that its charges are true that it becomes judge in its own cause. They object further because, on judicial review, the case comes to the court with the facts already found and with the findings of fact conclusive upon the court if supported by substantial evidence.

In response to this criticism the proposals have been various. At one time there was considerable discussion of the advisability of creating a central administrative court empowered to review administrative adjudications and in so doing to reweigh the evidence. In 1937 the president's committee on administrative management proposed complete separation of the two functions by vesting that of prosecution in an administrative section under the control of the appropriate executive department and that of making decisions in a judicial section which would be independent of the department except in matters of "housekeeping." In 1941 the U.S. attorney general's committee on administrative procedure advocated preservation of the unified over-all responsibility of the board or commission at the same time that its staff is provided with independent hearing commissioners empowered to conduct hearings and to make decisions appealable to it.

In the U.S. criticism culminated in specific efforts to "curb" administrative authority by general legislation intended to extend the scope of judicial review or to impose procedural safeguards. Outstanding among such efforts were a proposal made in 1938 by a New York state constitutional convention and the Logan-Walter bill passed in 1940 by the U.S. congress; but the former measure was rejected by the New York electorate, and the latter was vetoed by the president.

The problem is a real one, and goes to the heart of the purposes of administrative law. Unfortunately, however, the discussion is too often conducted by partisans who forget the ideal of the golden mean. Apologists for untrammelled administrative authority think only of the need for effective enforcement of policies intended to protect the general welfare by the regulation of private economic power, and forget that fairness to those regulated is a factor in the general welfare. Critics of administrative adjudication think only of the traditional safeguards of the rule of law, and forget that without modification these safeguards would hamstring modern government in its necessary effort to maintain the public interest by defending all the other major private groups against the abuse of power by any one of them.

Thus some of the traditionalists tend to assume an analogy between the modern bureaucrat and James I or between the modern administrative tribunal and the star chamber. The analogy, however, is misleading. The task of the Stuart period in English constitutional history was to render arbitrary political power responsible to the nation; while the task of the 20th century is to employ responsible political power for the purpose of imposing responsibility to the community upon the arbitrary economic power which the industrial-technological revolution has centred in various special groups. This new and different task calls for new tools which are more flexible than detailed legislation enforced by the judicial process. The modern bureaucrat is one of these indispensable tools.

This does not mean, however, that the modern bureaucrat is to be treated as a philosopher-king to whose wisdom and benevolence may be assigned the government of mankind. The bureaucrat can no more safely be entrusted with irresponsible power than an hereditary monarch or an independent judge. It follows that questions of executive accountability and bureaucratic responsibility, which are always with us, have become more pressing than ever before.

The industrial revolution created a new situation; and in all new situations the intelligent approach is neither to scrap traditional methods nor blindly to adhere to their outmoded forms. The problem is partly one of readaptation. Judicial review is an historic safeguard which should be reinterpreted in terms which are meaningful under modern conditions; but this reinterpretation should preserve as much of the old as is compatible with the effectiveness of administrative action in the public interest. The problem is also partly one of invention. New safeguards must be invented to take the place of those particular features of the rule of law which are no longer workable. One avenue for creative thought leads in the direction of improvement of administrative personnel; but the future may hold new answers of which nobody has yet dreamed. Such an approach calls for careful appraisal in contradistinction to both negative criticism and uncritical acceptance of the administrative function.

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(J. HT.)

**ADMINISTRATIVE REGULATION** can best be defined by contrasting it with legislative regulation. The latter consists in the detailed determination of rights and duties by statute and their enforcement, either at the instance of private parties or on the government's initiative, by means of the regular law enforcement machinery. Administrative regulation, by contrast, leaves much more to the discretion of government officials, generally members of specialized administrative agencies which normally possess considerable independence from the cabinet or chief executive. This power may be exercised by issuing general rules elaborating broad statutory grants of authority, by granting, denying, or revoking licences or permits, or by issuing mandatory orders.

Discretionary administrative power is in no sense a new phenomenon. The licensing power in particular has long been used, especially for the protection of the public health and safety. Restaurants, for example, commonly are not permitted to operate without a licence, which can be secured only by meeting certain standards of sanitation. But the term "administrative regulation" usually refers to the application of the administrative method to the regulation of business for what may be broadly termed economic objectives. In this sense administrative regulation is a comparatively recent development.

In England the establishment of a Railway commission in 1873 may be taken as the starting point. This semi-administrative tribunal was little more than a specialized court, but its weakness led to the creation later of agencies with more power. The Railway Rates tribunal, which was set up in 1921, still is more of a court than an administrative regulatory agency; however, it does

possess extensive discretionary authority, although it still has no power to initiate proceedings. The Electricity commissioners, established in 1919 for the licensing of electricity suppliers, have quite broad regulatory powers. They have complete control over who shall produce electricity and under what conditions and at what prices. After 1930, public service passenger vehicles using streets and highways have, like railways, been subject to extensive control. In this case, moreover, the law is administered by authorities (the Area Traffic commissioners) who possess wide discretionary powers and do not follow a rigid, legalistic procedure. Similar but more limited regulation was extended to goods transport (trucking) in 1933. In a slightly different category are the various boards set up by authority of the Agricultural Marketing acts of 1931 and 1933. Producers of a given commodity may secure the permission of the minister of agriculture for the establishment of a board whose members they elect and who possess extensive powers over the marketing activities of the group. The trend after 1936 has been away from producer-controlled regulatory authorities and several acts have provided boards or commissions for particular industries with members appointed by the appropriate minister. The Cotton Industry board, established in 1939, exemplifies this trend and also is significant for its extension of administrative control into a new field.

Administrative regulation has found wider use and been more fully developed in the United States than in England. It was the need for controlling the discriminatory practices and other abuses of the railroads which led, in the United States, as in England, to the first resort to administrative regulation in the modern sense. The Interstate Commerce commission was created in 1887 for this purpose. Reinforced by the Hepburn act of 1906 and subsequent amendments to the Interstate Commerce act, it became the archetype of American regulatory commissions, combining quasi-legislative, quasi-judicial and purely administrative powers. Chief among the commissions which followed in the wake of the Interstate Commerce commission are the Federal Trade commission (1914), the Federal Power commission (1920), the Federal Communications commission (1927, 1934), the Securities and Exchange commission (1934), the National Labor Relations board (1935), the United States Maritime commission (1916, 1936), and the Civil Aeronautics board (1938, 1940). (Where two dates are given the earlier applies to a predecessor agency with a different title ) In some cases broad regulatory powers are given to a department head, as to the secretary of agriculture by the Packers and Stockyards act of 1921 and by the Agricultural Adjustment act of 1938. A similar development has taken place in the states.

Some conception of the powers wielded by these agencies may be had from an enumeration of legislative standards which they apply. These include "reasonable rates," "public convenience and necessity," "unreasonable discrimination," and "unfair labour practices [which] interfere with, restrain, or coerce employes [or] dominate or interfere with any labour organization."

The increasing reliance upon governmental regulation of economic activities, the mounting complexities of those activities themselves and the trend toward substituting prevention for punishment comprise the major causes of the growing use of the administrative method. This method enables the legislature to leave to others the elaboration of detailed regulations for which it has neither the time nor the competence. It also provides expert agencies far better fitted than the courts for the application of regulatory legislation. Without the flexibility of this form of regulation, legislatures would be at a loss to cope with many of the problems confronting them by a dynamic industrialized society.

Like every new form of power, administrative regulation involves its own peculiar dangers and abuses, for which it has been severely criticized. Because of the broad discretion commonly delegated to regulatory authorities, it is complained that a cardinal principle of the "rule of law," that rights and duties should be clearly stated in advance of action by the government, is violated. Discretion also opens the door to arbitrary action The fact that it is common practice to grant these agencies a considerable amount of autonomy leads to the objection that they are undemocratic. Finally, the fact that a single agency makes investigations and findings of fact, brings charges, hears the replies to the charges, and renders decisions, is alleged to violate the principle that the same person should not be both prosecutor and judge—and also, in the United States, the doctrine of the separation of powers.

In practice, adequate safeguards against these abuses have been developed and are generally applied. They include numerous procedural devices, such as, opportunity for hearings, the requirement that all decisions affecting private rights be accompanied by a published statement of reasons, and the separation of the prosecuting and the adjudicating functions within the agencies' staffs. Although administrative agencies are not rigidly bound by precedent, they find it to their own great advantage to develop standards for their guidance and to adhere to consistent policies. Nor are they by any means unchecked from without. On the contrary, they operate within legislative grants of authority, by means of annual appropriations, and frequently are subject to legislatively prescribed procedure. They are also liable to control by the judiciary, at least to the extent that the courts will determine whether they have acted within the authority of and subject to, the restrictions laid down by the legislature, and, in the United States, whether they have complied with the requirements of "due process of law." Finally, they are responsible in varying degrees to the executive branch of the government.

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**ADMINISTRATOR:** *see* WILL OR TESTAMENT.

**ADMIRABLE CRICHTON:** *see* CRICHTON, JAMES.

**ADMIRAL,** the rank and title of the naval officer who commands a fleet or subdivision of a fleet. In the United States navy there are four grades of admiral, *i.e.,* admiral of the fleet, admiral, vice-admiral, rear admiral, in descending order of seniority. The first was created, 1899, for Admiral George Dewey. The second and third, corresponding to general and lieutenant general in the army, were created in 1866. In the British navy there are four corresponding grades: admiral of the fleet, admiral, vice-admiral and rear admiral. These titles superseded those of admiral of the blue, red and white.

The rank of admiral essentially applies to flag officers of the military branch who have commanded, or who have qualified to command, a fleet or squadron at sea. In the U.S. navy, certain officers of the nonmilitary branches are given the rank of: rear admiral, medical corps; rear admiral, supply corps; rear admiral, construction corps; rear admiral, civil engineer corps. They are not flag officers

The corresponding ranks in the United States services are:

| NAVY | ARMY |
|---|---|
| Admiral of the fleet | General of the army |
| Admiral | General |
| Vice-admiral | Lieutenant general |
| Rear admiral | Major general |
| Commodore | Brigadier general |

The rank of commodore, after being abandoned for a long period, was re-established in 1943.

The corresponding ranks in the British services are:

| Navy | Army | Air Force |
|---|---|---|
| Admiral of the fleet | Field marshal | Marshal of the royal air force |
| Admiral | General | Air chief marshal |
| Vice-admiral | Lieut general | Air marshal |
| Rear admiral | Major general | Air vice-marshal |

In the United States the ranks of admiral and vice-admiral are temporarily conferred (ex officio) upon the following commanders:

| Admiral | Vice-Admiral |
|---|---|
| Chief of naval operations | Commander scouting force |
| Commander in chief, U S fleet | Commander battleships |
| Commander in chief, Atlantic fleet | Commander aircraft |
| Commander in chief, Pacific fleet | |
| Commander battle force | |

The chiefs of bureau in the U S. navy rank as rear admirals.

It is exceptional for an admiral of the fleet to fly his flag at sea in peacetime. Commanders in chief of the main British fleet and of the premier home ports—Portsmouth and Plymouth—are generally full admirals, and the lesser independent commands and seconds-in-command are vice-admirals or rear admirals. The political and administrative head of the British navy up to the year 1546 was known as the lord high admiral, which office is now executed by the lords commissioners of the admiralty. There still remain the honorary titles of vice- and rear admiral of Great Britain, in compliment to selected senior flag officers. (W. B. Ck.)

**ADMIRALTY.** The department of state that advises the British government and takes the necessary executive action on all questions relating to the interests and territories of the British empire by sea is the admiralty. It is also responsible for building, manning, maintaining and administering the royal navy.

The board of admiralty consists of lords commissioners who were originally appointed by royal letters patent to execute the office of lord high admiral, the powers of which office were statutorily vested in commissioners by the Admiralty act of 1690, although the system whereby responsibility centred in a single high officer—the lord high admiral of the United Kingdom—was virtually terminated in the reign of Henry VIII.

From time to time after that date, the sovereign exercised the royal prerogative to revive the office of lord high admiral, as, for example, when Charles II conferred it on his brother, James, duke of York (afterward James II); but after the reign of Queen Anne only one such appointment was made, that of the duke of Clarence (afterward William IV), who held the office of lord high admiral in 1827–28.

For nearly three centuries before the Admiralty act of 1832, administration of the service was the responsibility of a separate body known as the navy board. The constitution of this board varied, but it was nearly always riddled with political influence and frequently with corruption and inefficiency. Under that act, the board of admiralty was invested with all the powers and duties of the navy board and also of a third organization, the victualling board. Yet another organization, originally instituted specially for the navy, was the ordnance committee, but this passed into military hands and was long a byword for sloth and inefficiency. It became a joint concern in 1881 and, under the title of ordnance board, came to deal with design and trials of ordnance for all three services.

The constitution of the board of admiralty under the act of 1832 provided for superintending lords of the various departments but for no organization for war planning or the conduct of operations, with the result that the system broke down badly when it was put to the test by the Crimean War. Various attempts at reform were made, notably by H. C. E. Childers on becoming first lord in 1868 and then by G. J. Goschen who succeeded him in 1871. But no proper naval staff existed until Winston Churchill was appointed to that office in 1911; even then it was not properly constituted nor given the necessary standing to prevent several naval disasters and the miscarriage of the Dardanelles campaign in the early part of World War I.

As that war developed, it became evident that the departmental lords were too fully occupied with administration and supplies to be able to take an effective part in that joint responsibility for the operational side of the naval war which constitutionally they were expected to do. In the autumn of 1917, after Adm. John R. (later Earl) Jellicoe had become first sea lord, the naval staff system was put on an altogether sounder basis. In effect, there became two separate though closely co-operating bodies within the admiralty, one dealing with the operations and the other with the maintenance of the navy. Although there were modifications in detail, this remained the governing principle in the organization of the admiralty

At mid-20th century the constitution of the board of admiralty, as laid down by Order in Council of May 21, 1947, was as follows:

The first lord; the first sea lord and chief of naval staff, the second sea lord and chief of naval personnel, the third sea lord and controller of the navy; the fourth sea lord and chief of supplies and transport; the fifth sea lord and deputy chief of naval staff (air), the vice-chief of naval staff; the assistant chief of naval staff; the parliamentary and financial secretary; the civil lord; and the permanent secretary.

The first lord is responsible to the king and to parliament for all the business of the admiralty; in the exercise of this over-all responsibility he may assign to the other members of the board such duties and responsibilities as he may think fit. The following is a brief statement of the duties and responsibilities so exercised by other members of the board, subject to the overriding responsibility of the first lord and to the reservation that the first sea lord in his personal capacity remains responsible to parliament for professional advice on naval affairs generally.

The first sea lord is the chief naval professional adviser to the government and the first lord. He is also chief of the naval staff and as such is assisted by the vice-chief of naval staff, the deputy chief of naval staff (air) and the assistant chief of naval staff, who are all members of the board. The naval staff, under the chief of the naval staff and his supporting lords commissioners, is responsible for the formulation of strategical policy, including strategical planning, formulation of tactical doctrine, disposition of the fleet and the statement of the broad requirements both as regards quantities and specifications of H M ships and their fighting equipment

The second sea lord is responsible for the recruitment and entry of officers and men of the royal navy and royal marines and for their training, discipline, welfare, education and the general administration of admiralty establishments connected therewith. He is also responsible for the recruitment, training and administration of the women's royal naval service and naval reserves. The third sea lord is responsible for the construction, equipment and repair of ships and their armaments; for research and development; for the oversight of admiralty establishments connected therewith; and for the supply, distribution and maintenance of all warlike stores. The fourth sea lord is responsible for the provision of naval, victualling and medical stores, and fuel for the fleet, and for the movement of persons and matériel as required for the naval service. He is also concerned with pay, allowances and pensions. The fifth sea lord is responsible for the general direction and co-ordination of policy on all naval air matters. In his capacity as deputy chief of naval staff (air), the fifth sea lord deputizes for the chief and vice-chief of naval staff as necessary.

The parliamentary and financial secretary assists the first lord in his parliamentary duties and in connection with matters relating to the financial policy.

The civil lord assists the first lord in his parliamentary duties and has a general responsibility for works services and for the conditions of service of the admiralty's industrial employees.

The permanent secretary is responsible for general co-ordination of admiralty business on behalf of the board; the interior economy of the admiralty office; the administration of the civil staff; and for navy contracts. As accounting officer for navy votes he is responsible for the control of expenditure and is adviser to the board of admiralty on financial questions. He is responsible for paying, receiving and accounting for all moneys administered by the department.

The only lords who automatically resign when the prime minister resigns are the first lord and the civil lord, both being mem-

bers of parliament.

The naval staff of the admiralty consists essentially of picked naval officers of the rank of commander and above, working under the orders of the chief of naval staff (first sea lord) and his supporting sea lords, with the necessary civilian clerical staff It is responsible for the collection of intelligence; the formulation of strategical policy, including strategical planning, and of tactical doctrine; it states broad requirements as regards numbers and design of H.M ships, their weapons and equipment; it studies the changes in naval warfare consequent on scientific and technical developments; it advises on weapon training and on the priorities to govern the effort to be devoted to the various details of armaments.

An ever increasing amount of attention was devoted by the naval staff during the 20th century to naval aviation in all aspects. Indeed, the air branch became the most important one in the service, and was strongly represented in the admiralty. Numerically, however, the greater part of the admiralty was still devoted to the administration, manning, construction, equipment and supplying of the navy at mid-century. Many of the departments concerned with these matters, under their respective superintending sea lords, had a steady flow of naval officers bringing to them up-to-date practical and professional knowledge of sea-going requirements; others of a less essentially naval character were staffed entirely by civil servants. The admiralty had its own scientists, but it also shared scientific research with the other two service departments through the medium of the ministry of defence.

The most spacious part of the admiralty building in London runs across the north side of the Horse Guards parade; adjoining it is the old building with its beautiful frontage in Whitehall. The latter dates from 1723. An ugly excrescence, popularly known as "Lenin's tomb," was built on at the northwest corner during World War II to provide a bombproof retreat in case of damage to the normal accommodation.

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**ADMIRALTY, HIGH COURT OF.** The High Court of Admiralty of England was the court of the deputy or lieutenant of the admiral. It is supposed in the *Black Book of the Admiralty* to have been founded in the reign of Edward I.; but it would appear, from the learned discussion of R. G. Marsden, that it was established as a civil court by Edward III. in the year 1360; the power of the admiral to determine matters of discipline in the fleet, and possibly questions of piracy and prize, being somewhat earlier. At first there were separate admirals or rear-admirals of the north, south and west, each with deputies and courts. A list of them was collected by Sir H. Spelman. These were merged in or absorbed by one high court early in the 15th century. Sir Thomas Beaufort, afterwards earl of Dorset and duke of Exeter (appointed admiral of the fleet 1407, and admiral of England, Ireland and Aquitaine 1412, which latter office he held till his death in 1426), certainly had a court, with a marshal and other officers, and forms of legal process—mandates, warrants, citations, compulsories, proxies, etc. Complaints of encroachment of jurisdiction by the admiralty courts led to the restraining acts, 13 Ric. II. c. 5 (1389), 15 Ric. II. c. 3 (1391) and 2 Hen. IV. c. 11 (1400).

**Jurisdiction.**—The original object of the institution of the courts or court seems to have been to prevent or punish piracy and other crimes upon the narrow seas and to deal with questions of prize; but civil jurisdiction soon followed. The jurisdiction in criminal matters was transferred by the Offences at Sea Act, 1536, to the admiral or his deputy and three or four other substantial persons appointed by the lord chancellor, who were to proceed according to the course of the common law. By the Central Criminal Court Act, 1834, cognizance of crimes committed within the jurisdiction of the admiralty was given to the central criminal court. By an act of 1844 it has been also given to the justices of assize; and crimes done within the jurisdiction of the admiralty are now tried as crimes committed within the body of a county. *See* also the Criminal Law Consolidation Acts of 1861.

From the time of Henry IV. the only legislation affecting the civil jurisdiction of the High Court of Admiralty till the time of Queen Victoria is to be found in an act of 1540, enabling the admiral or his lieutenant to decide on certain complaints of freighters against shipmasters for delay in sailing, and one of 1562, giving the lord [illegible] of England, the lord warden of the Cinque Ports, their lieutenants and judges, co-ordinate power with other judges to enforce forfeitures under that act—a very curious and miscellaneous statute called "An Act for the Maintenance of the Navy."

In an act of 1534, with regard to ecclesiastical appeals from the courts of the archbishops to the Crown, it is provided that the appeal shall be to the king in Chancery, "and that upon every such appeal a commission shall be directed under the great seal to such persons as shall be named by the king's highness, his heirs or successors, like as in cases of appeal from the Admiralty Court." It is only in this incidental recognition that recorded authority for appeals from the admiralty to persons commissioned under the great seal is to be found. The appeal to these "persons," called delegates, continued until it was transferred first to the Privy Council and then to the judicial committee of the Privy Council by acts of 1832 and 1833.

The early jurisdiction of the court appears to have been exercised very much under the same procedure as that used by the courts of common law. Juries are mentioned, sometimes of the county and sometimes of the county and merchants. But the connection with foreign parts led to the gradual introduction of a procedure resembling that coming into use on the Continent and based on the Roman civil law.

**Restraining Acts.**—The material enactments of the restraining statutes were as follows:—An act of 1389 (13 Ric. II. c. 5) provided that "the admirals and their deputies shall not meddle from henceforth of anything done within the realm, but only of a thing done upon the sea, as it hath been used in the time of the noble prince king Edward, grandfather of our lord the king that now is." The Act of 1391 (15 Ric. II. c. 3) provided that "of all manner of contracts, pleas and quarrels, and other things rising within the bodies of the counties as well by land as by water, and also of wreck of the sea, the admiral's court shall have no manner of cognizance, power, nor jurisdiction; but all such manner of contracts, pleas and quarrels, and all other things rising within the bodies of counties, as well by land as by water, as afore, and also wreck of the sea, shall be tried, determined, discussed and remedied by the laws of the land, and not before nor by the admiral, nor his lieutenant in any wise. Nevertheless, of the death of a man, and of a mayhem done in great ships, being and hovering in the main stream of great rivers, only beneath the (bridges) of the same rivers (nigh) to the sea, and in none other places of the same rivers, the admiral shall have cognizance, and also to arrest ships in the great flotes for the great voyages of the king and of the realm; saving always to the king all manner of forfeitures and profits thereof coming; and he shall have also jurisdiction upon the said flotes, during the said voyage only; saving always to the lords, cities, and boroughs, their liberties and franchises." The statutes of Richard, except the enabling part of the second, were repealed by the Civil Procedure Acts Repeal Act, 1879. The formation of a High Court of Justice rendered them obsolete.

In the reign of James I. the chronic controversies between the courts of common law and the admiralty court as to the limits of their respective jurisdictions reached an acute stage. We find the records of it in the second volume of Marsden's *Select Pleas in the Court of Admiralty,* and in Lord Coke's writings: *Reports,* part xiii. 51; *Institutes,* part iv. chap. 22. In this latter passage Lord Coke records how, notwithstanding an agreement asserted to have been made in 1575 between the justices of the King's Bench and the judge of the admiralty, the judges of the common law courts successfully maintained their right to prohibit suits in admiralty upon contracts made on shore, or within havens, or creeks, or tidal rivers, if the waters were within the body of

any county, wheresoever such contracts were broken, for torts committed within the body of a county, whether on land or water, and for contracts made in parts beyond the seas. It is due to the memory of the judges of Lord Coke's time to say that, at any rate as regards contracts made *in partibus transmarinis*, the same rule appears to have been applied at least as early as 1544, the judges then holding that "for actions transitory abroad, action may lie at common law."

**Judge's Patent.**—All the while, however, the patents of the admiralty judge purported to confer on him a far ampler jurisdiction than the jealousy of the other courts would concede to him The patent of the last judge of the court, Sir Robert Joseph Phillimore, dated Aug 23, 1867, styles him "Lieut. Offl Princl and Commissary Genl and Special in our High Court of Admiralty of Eng. and President and Judge of the same," and gives to him power to take cognizance of "all causes, civil and maritime, also all contracts, complaints, offences or suspected offences, crimes, pleas, debts, exchanges, accounts, policies of assurance, loading of ships, and all other matters and contracts which relate to freight due for the use of ships, transportation, money or bottomry; also all suits civil and maritime between merchants or between proprietors of ships and other vessels for matters in, upon, or by the sea, or public streams, or fresh-water ports, rivers, nooks and places overflown whatsoever within the ebbing and flowing of the sea, and high-water mark, or upon any of the shores or banks adjacent from any of the first bridges towards the sea through England and Ireland and the dominions thereof, or elsewhere beyond the seas." Power is also given to hear appeals from vice-admirals; also "to arrest . . . according to the civil laws and ancient customs of our high court . . . all ships, persons, things, goods, wares and merchandise"; also "to enquire by the oaths of honest and lawful men . . . of all . . . things which . . . ought to be enquired after, and to mulct, arrest, punish, chastise, and reform"; also "to preserve the public streams of our admiralty as well for the preservation of our royal navy, and of the fleets and vessels of our kingdom . . . as of whatsoever fishes increasing in the rivers"; also "to reform nets too straight and other unlawful engines and instruments whatsoever for the catching of fishes"; also to take cognizance "of the wreck of the sea . . . and of the death, drowning and view of dead bodies," and the conservation of the statutes concerning wreck of the sea and the office of coroner (1276), and concerning pillages (1353), and "the cognizance of mayhem" within the ebb and flow of the tide; all in as ample manner and form as they were enjoyed by Dr. David Lewis (judge from 1558 to 1584), Sir Julius Caesar, and the other judges in order (22 in all) before Sir Robert Phillimore. This form of patent differs in but few respects from the earlier Latin patents—*tempore* Henry VIII.—except that they have a clause *non obstantibus statutis*.

**Modern Progress.**—As has been said, however, the contention of the common law judges prevailed, and the admiralty court (except for a temporary revival under Cromwell) sank into comparative insignificance during the 17th century. The great maritime wars of the 18th century gave scope to the exercise of its prize jurisdiction; and its international importance as a prize court in the latter half of the 18th and the first part of the 19th centuries is a matter of common historical knowledge. There were upwards of 1,000 prize causes each year between 1803 and 1811, in some years upwards of 2,000.

There were other great judges; but Sir William Scott, afterwards Lord Stowell, is the most famous. Before his time there were no reports of admiralty cases, except Hay and Marriott's prize decisions. But from his time onwards there has been a continuous stream of admiralty reports, and we begin to find important cases decided on the instance as well as on the prize side.

In the reign of Queen Victoria, two enabling statutes, 1840 and 1861, were passed and greatly enlarged the jurisdiction of the court. The manner in which these statutes were administered by Dr. Stephen Lushington and Sir R. J. Phillimore, whose tenure of office covered the whole period of the queen's reign till the creation of the High Court of Justice, the valuable assistance rendered by the nautical assessors from the Trinity House, the great increase of shipping, especially of steam shipping, and the number and gravity of cases of collision, salvage and damage to cargo, restored the activity of the court and made it one of the most important tribunals of the country. In 1875, by the operation of the Judicature Acts of 1873 and 1875, the High Court of Admiralty was with the other great courts of England formed into the High Court of Justice The principal officers of the court in subordination to the judge were the registrar (an office which always points to a connection with canon or civil law), and the marshal, who acted as the maritime sheriff having for his baton of office a silver oar. The assistance of the Trinity Masters which has been already mentioned, was provided for in the charter of incorporation of the Trinity House. These officers and their assistance have been preserved in the High Court of Justice.

**Practitioners in the Court.**—Till the year 1859 the practitioners in the High Court of Admiralty were the same as those in the ecclesiastical courts and distinct from those who practised in the ordinary courts. Advocates took the place of barristers, and proctors of solicitors. The place of the attorney-general was taken by the king's or queen's advocate-general, and that of the treasury solicitor by the king's or queen's procurator or proctor. There were also an admiralty advocate and an admiralty proctor

In an act of 1859 the practice was thrown open to barristers and to attorneys and solicitors.

Upon the next vacancy after the courts were thrown open, the Crown altered the precedence and placed the queen's advocate after the attorney- and solicitor-general. There were two holders of the office under these conditions, Sir R. J. Phillimore and Sir Travers Twiss. The office was not filled up after the resignation of the latter, nor was the office of admiralty advocate filled up when next it became vacant

**Ireland.**—The High Court of Admiralty of Ireland, being formed on the same pattern as the High Court in England, sat in the Four Courts, Dublin, having a judge, a registrar, a marshal and a king's or queen's advocate. In peace time and war time alike it exercised only an instance jurisdiction, though in 1793 it claimed to exercise prize jurisdiction (*see* ADMIRALTY JURISDICTION) No prize commission ever issued to it. By the Irish Judicature Act of 1877 it was directed that it should be amalgamated with the Irish High Court of Justice upon the next vacancy in the office of judge, and this subsequently took place. There was no separate lord high admiral for Ireland.

**Scotland.**—At the Union, while the national functions of the lord high admiral were merged in the English office it was provided by the Act of Union that the Court of Admiralty in Scotland should be continued "for determination of all maritime cases relating to private rights in Scotland competent to the jurisdiction of the Admiralty Court." This court continued till 1831, when its civil jurisdiction was given to the Court of Session and the Sheriffs' Courts (*see* ADMIRALTY JURISDICTION).

*See* J. Godolphin, *View of the Admiral Jurisdiction* (1661); Sir Travers Twiss, *Black Book of the Admiralty*, Rolls' series (1871); R. G. Marsden, *Select Pleas in the Court of Admiralty*, published by the Selden Society (1894). (P.)

**ADMIRALTY ISLANDS,** a group of about 40 islands in the Bismarck archipelago, north of New Guinea, between 1° and 3° S. and 146° and 148° E. The largest of the islands is Manus, sometimes called Great Admiralty island; its principal town is Lorengau, on the northeastern coast of Manus. The estimated native population in 1940 was 13,450 and there were 37 non-native inhabitants. The principal economic activities of the islands are coco-nut plantations (10,457 hectares under cultivation in 1940) and pearl and other shell fisheries. Manus has hills running up to 3,000 ft.; the other islands are mostly low and of coral formation. The Admiralty islands were formerly part of the German protectorate, which also included eastern New Guinea, from 1885 until 1914. They were then occupied by Australian troops and were assigned to Australian administration as part of the League of Nations mandate for eastern New Guinea, which included adjacent islands. They were invaded by the Japanese in Jan. 1942, during the southward sweep that brought them to the northern coast of New Guinea and to the Solomons. The natives are Papuans, with a variety of local dialects, addicted to cannibalism and not hospitable to strangers, although they were tamed to some extent under the man-

datory administration. The islands were discovered by Dutch navigators in 1616 and were visited by Philip Carteret in 1767. The first landing, however, was from the "Challenger" in 1875.

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**ADMIRALTY JURISDICTION.** The courts by which, as far as we know, admiralty jurisdiction in civil matters was first exercised were the following. In and throughout England the courts of the several admirals soon combined into one High Court of Admiralty (*see* ADMIRALTY, HIGH COURT OF). Within the territories of the Cinque Ports the Court of Admiralty of the Cinque Ports exercised a co-ordinate jurisdiction In certain towns and places there were local courts of vice-admiralty. In Scotland there existed the Scottish High Court of Admiralty, in Ireland the Irish High Court of Admiralty. Of these courts that of the Cinque Ports alone remains untouched. The Scottish Court was abolished, and its civil jurisdiction given to the Court of Session and to the courts of the sheriffs by the Court of Session Act, 1830—not, however, till a decision given by it and the appeal therefrom to the House of Lords had established a remarkable rule of admiralty law in cases of collision (*Hay* v. *le Neve*, 1824, 2 Shaw, Sc. App. Cas. 395). The act states that the Court of Justiciary held cumulative jurisdiction with the Court of Admiralty in criminal matters. The local vice-admiralty courts in England had ceased to do much work when they were abolished by the Municipal Corporations Act, 1835. The High Court became, with the other superior courts, a component part of the High Court of Justice by virtue of the Judicature Acts, 1873 and 1875 And the Irish Court in like manner became a part of the High Court of Justice in Ireland by virtue of the Judicature Act passed in 1877.

**Vice-Admiralty Courts.**—As England first, and Great Britain afterwards, acquired colonies and possessions beyond seas, vice-admiralty courts were established. The earliest known was that in Jamaica, established in the year 1662. Some vice-admiralty courts created for prize purposes in the eighteenth century were suffered to expire after 1815. In the year 1863, when the act regulating the vice-admiralty courts was passed, there were vice-admiralty courts established in 45 several portions of the King's dominions; to which by an act of 1867 one for the Straits Settlements was added. These courts have been regulated from time to time by the following statutes: 2 and 3 Will. IV. c. 51, 26 and 27 Vict. c. 24 (Vice-Admiralty Courts Act, 1863), already cited, and 30 and 31 Vict. c. 45 (Vice-Admiralty Courts Act Amendment Act, 1867); and by the slave trade acts, of which the last and consolidating act was that of 1873.

In 1890 the Colonial Courts of Admiralty Act provided that, except in the colonies of New South Wales, Victoria, St. Helena and British Honduras, vice-admiralty courts should be abolished and colonial courts of admiralty substituted. There is power, however, reserved to the Crown to erect through the admiralty in any British possession any vice-admiralty court, except in India or any British possession having a representative legislature. No vice-admiralty court so established can exercise any jurisdiction except for some purpose relating to prize, the royal navy, the slave trade, foreign enlistment, Pacific Islanders' protection, and questions relating to treaties or conventions on international law.

**Colonial Courts of Admiralty.**—By the Colonial Courts of Admiralty Act, 1890 already referred to, every court of law in a British possession which is declared by its legislature to be such, or if there be no such declaration, which has original unlimited civil jurisdiction, shall be a court of admiralty.

There used to be vice-admiralty courts for Calcutta, Madras and Bombay; but by the India High Courts Act, 1861, s. 9, the admiralty jurisdiction was given to the High Courts of these places.

**Consular Courts.**—Admiralty jurisdiction was given to the consular courts in China, Japan and Turkey (those in Japan and Turkey have disappeared with the capitulations), and by s. 12 of the Colonial Admiralty Courts Act any court established by H.M. for the exercise of jurisdiction in any place outside H.M.'s dominion may have admiralty jurisdiction granted to it.

**Australia.**—By the Commonwealth of Australia Constitution Act, 1900, a federal supreme court, to be called the High Court of Australia, is created, and the parliament of the Commonwealth may make laws conferring original jurisdiction on the High Court in matters of admiralty and maritime jurisdiction.

**Isle of Man.**—There is a court of admiralty in the Isle of Man of which the water-bailiff is judge. He is also styled admiral It is said to have jurisdiction in salvage and over other maritime matters occurring within three leagues from the shore.

**County and Local Courts.**—Modern statutes have given admiralty jurisdiction to the City of London Court, Court of Passage and to county courts in the following matters. Salvage, where the value of the salved property does not exceed £1,000, or the claim for reward £300; towage, necessaries and wages, where the claim does not exceed £150; claims for damage to cargo, or by collision, up to £300 (and for sums above these prescribed limits by agreement between the parties); and claims arising out of breaches of charter parties and other contracts for carriage of goods in foreign ships, or torts in respect thereof, up to £300 This jurisdiction is restricted to subjects over which jurisdiction was possessed by the High Court of Admiralty at the time when the first of these acts was passed, except as regards the last branch of it (the *Aline*, 1880, 5 Ex. Div. 227; *R* v. *Judge of City of London Court* [1892] 1 Q B. 272). In analogy with the county court admiralty jurisdiction created in England, a limited admiralty jurisdiction was given in Ireland to the recorders of certain boroughs and the chairmen of certain quarter sessions; in salvage cases, where a county court in England would have jurisdiction, magistrates, recorders and chairmen of quarter sessions may have jurisdiction as official arbitrators (Merchant Shipping Act, 1894, s. 547). In Scotland, admiralty suits in cases not exceeding the value of £25 are exclusively tried in the sheriff's court; while over that limit the sheriff's court and the court of session have concurrent jurisdiction. The sheriff has also criminal admiralty jurisdiction, but only as to crimes which he would be competent to try if committed on land (The Court of Session Act, 1830, ss. 21 and 22).

By an act of 1821 an arbitral jurisdiction in cases of salvage was given to certain commissioners of the Cinque Ports.

The appeal from county courts and commissioners is to the High Court of Justice, and is exercised by a divisional court of the Probate, Divorce and Admiralty Division. In cases arising within the Cinque Ports there is an optional appeal to the Admiralty Court of the Cinque Ports The appeal from the High Court of Justice is in ordinary admiralty matters, as in others, to the Court of Appeal and from thence to the House of Lords.

**Civil Jurisdiction.**—In the high courts, whether in England, Scotland or Ireland, it is not now necessary to distinguish their civil admiralty jurisdiction, from their ordinary civil jurisdiction, except for the purpose of seeing whether there can or cannot be process *in rem*. Not that every admiralty action can of right be brought *in rem*, but that no process *in rem* lies at the suit of a subject unless it be for a matter of admiralty jurisdiction—one, for instance, that could in England have been tried in the High Court of Admiralty. Now these matters of admiralty jurisdiction with process *in rem* range themselves under four primary and four supplementary heads. The four primary are damage, salvage, bottomry, wages; and the four supplementary are extensions due to one or other of the statutes of 1840 (Admiralty Court) and 1861 (Admiralty Court Act). They are damage to cargo carried in a ship, necessaries supplied to a ship, mortgage of ship, and master's claim for wages and disbursements on account of a ship. In all these cases, primary and secondary, the process of which a plaintiff can avail himself for redress, may be either *in personam* as in other civil suits, or by arrest of the ship, and, in cases of salvage and bottomry, the cargo. Whenever, also, the ship can be arrested, any freight due can also be attached, by arrest of the cargo to the extent only of the freight which it has to pay. For the purpose of ascertaining whether or not process *in rem* would lie, there have been distinctions as nice, and the line of admiralty jurisdiction has been drawn as carefully, as in the cases of the admiralty jurisdiction of the county courts (the

*Theta,* [1894] P. 280; the *Gas Float Whitton* [1897] App. Cas. 337). Similar questions have been raised in the U.S., from *De Lovio* v. *Boit* (1815, 2 Gall. 398), and *Ramsay* v. *Allegre* (1827, 12 Wheat. 611), down to the more modern cases which are quoted in the arguments and judgments in the *Gas Float Whitton.* The disciplinary jurisdiction once exercised by the Admiralty Court, over the royal navy and merchant vessels, may be said to be obsolete in time of peace, the last remnant of it being suits against merchantmen for flying flags appropriate to men-of-war (the *Minerva,* 1800 3, C. Rob. 34), a matter now more effectively provided against by the Merchant Shipping Act, 1894. In time of war, however, it was exercised in some instances as long as the Admiralty Court lasted, and is now in consequence exercisable by the High Court of Justice (*see* PRIZE COURTS AND PRIZE LAW). It was, perhaps, in consequence of its ancient disciplinary jurisdiction that the Admiralty Court was made the court to enforce certain portions of the Foreign Enlistment Act, 1870.

Finally, appeals from decisions of courts of inquiry, under the Merchant Shipping Act, cancelling or suspending the certificates of officers in the merchant service, may be made to the Probate, Divorce and Admiralty Division of the High Court of Justice.

**Criminal Cases.**—The Admiralty jurisdiction in criminal matters extends over all crimes committed on board British ships at sea or in tidal waters, even though such tidal waters be well within foreign territory (*R.* v. *Anderson,* 1868, L.R. 1 C.C.R. 161), but not over crimes committed on board foreign vessels upon the high seas (*R.* v. *Serva,* 1845, 1 Denison C.C. 104). Whether it extended over crimes committed on foreign ships within territorial waters of the United Kingdom, and whether a zone of three miles round the shores of the United Kingdom was for such purpose territorial water, were the great questions raised in *R.* v. *Keyn* (the *Franconia,* L.R. 2 Ex. Div. 126), and decided in the negative by the majority of the judges. Since then, however, the legislature has brought these waters within the jurisdiction of the admiralty by the Territorial Waters Jurisdiction Act, 1878. Section 2 runs as follows: "An offence committed by a person, whether he is or is not a British subject, on the open sea within the territorial waters of British dominions, is an offence within the jurisdiction of the admiral, although it may have been committed on board or by means of a foreign ship." By s. 7 the "jurisdiction of the admiral" is defined as "including the jurisdiction of the admiralty of England or Ireland, or either of such jurisdictions as used in any act of parliament" (*see* WATERS, TERRITORIAL).

Where portions of the sea and tidal waters, by reason of their partially land-locked positions are deemed to be in the body of a county, there is no [illegible] jurisdiction. Crimes are tried as if they were committed on land within the same county.

Pirates, whatever flag they pretended to fly, were, from 1360, wherever their crimes were committed, subject to admiralty jurisdiction. The criminal jurisdiction of the admiralty was first exercised by the High Court of Admiralty; and then, by the Offences at Sea Act, 1536, transferred to commissioners appointed under the great seal, among whom were to be the admiral or admirals, his or their deputies. Admiralty sessions were held for this purpose till 1834. Admiralty criminal jurisdiction is now, by virtue of the series of statutes, the Offences at Sea Act, 1799, the Central Criminal Court Act, 1834, Offences at Sea Act, 1844, and the criminal law consolidation acts passed in 1861, exercised by the Central Criminal Court and by the ordinary courts of assize. Special provision for trial in the colonies of offences committed at sea was made by William III (1698–99), in the Offences at Sea Act, 1806, and the Admiralty Offences (Colonial) Act, 1849. (P.)

*See* Clunet, *Journal du droit international privé;* E. C. Benedict, *Law of American Admiralty* (1940); E. S Roscoe, *The Admiralty Jurisdiction and Practice of the High Court of Justice,* 5th ed. (London, 1931), *Studies in the History of the Admiralty and Prize Courts* (London, 1932).

### UNITED STATES

Admiralty jurisdiction was exercised in the American colonies by vice-admiralty courts until the year 1776, then by the State admiralty courts until 1789. The Constitution, Art. III., s. 2, provides that the judicial power of the United States "shall extend to all cases of admiralty and maritime jurisdiction"

The Judiciary Act of 1789 (1 U.S.S.L. 76) granted original jurisdiction to United States district courts. The circuit courts were given concurrent original jurisdiction over seizures for slave trading, condemnations of property used by persons in insurrection (R.S. 629, 2nd ed.), and in the coolie trade (R.S.2159, 2nd ed.). The supreme court of the District of Columbia was given the same jurisdiction as that of the United States district courts in 1901 (31 U.S.S.L. 1199). Formerly the Judiciary Act authorized appeals from the district court to the circuit court and thence to the Supreme Court. This practice was abolished in 1891, and nine circuit courts of appeals were created (Judicial Code, s. 116). These were the final courts of appeal in admiralty, except that there was the right of a direct appeal to the Supreme Court on questions of jurisdiction (Judicial Code, s. 238), and that the Supreme Court might in its discretion review the judgments of the circuit court of appeals by writs of certiorari (Judicial Code, s. 240).

The circuit courts were abolished in 1911 (Judicial Code, s. 289) Direct appeals to the Supreme Court were abolished in 1925 (43 U.S.S.L. 938). Since then the district courts alone have original jurisdiction in all admiralty cases. Appeals lie to the circuit courts of appeal which may certify questions to the Supreme Court for opinion, and the Supreme Court may review the judgments of the circuit courts of appeal on writs of certiorari.

The district courts have jurisdiction in admiralty of suits against the United States in contract and in tort arising out of the operation of merchant vessels (41 U.S.S.L. 525), in tort, towage and salvage arising out of the operation of public vessels (43 U.S.S.L. 1112), and in certain cases concurrent jurisdiction with the court of claims in contract cases (24 U.S.S.L. 505; *Cornell S. S. Co.* v. *U.S.,* 202 U.S. 184). The district courts have jurisdiction over crimes and offences committed upon vessels of the United States wherever they may be afloat upon navigable waters, but they are tried according to common law criminal procedure (*U.S.* v. *Rodgers,* 150 U.S. 249; *Hamilton* v. *U.S.,* 268 Fed. 15).

**Actions in admiralty** may be either *in rem* with the arrest of the ship, or other maritime property, to enforce a maritime lien (a *jus in re*) or *in personam* against a person. Actions *in rem* are limited to courts of admiralty. Under s. 24 of the Judicial Code, "saving to suitors the right of a common law remedy where the common law is competent to give it," a right *in personam* may be enforced in a common law court, but the substantive rights of the parties are determined by the maritime law (*Southern Pacific* v. *Jensen,* 244 U.S. 205; *Knickerbocker Ice Co.* v. *Stewart,* 253 U.S. 149). Admiralty jurisdiction extends to all navigable waters, including rivers, lakes and canals connected with the sea (*The Hine,* 4 Wall, 555; *Robert W. Parson,* 191 U.S. 17). Admiralty jurisdiction extends to prize cases (*Jecker* v. *Montgomery,* 13 How. 498), to possessory and petitory suits (*The Schooner Tilton,* Fed. Cas. No. 14054; *Ward* v. *Peck,* 18 How. 267), to maritime contracts and torts. Maritime contracts are determined by their subject matter and in general they relate to ships as such, or to transportation of goods or passengers. They include charter-parties, contracts of affreightment, bills of lading, bottomry and respondentia bonds, salvage, towage, pilotage, stevedoring, supplies and repairs, advances, marine insurance policies, wages, preferred mortgages (41 U.S.S.L. 988, 1000; *ex parte Easton,* 95 U.S. 68). A contract to build a ship or furnish material for its completion is non-maritime (*Peoples Ferry Co.* v. *Beers,* 20 How. 393; *the Thames Co.* v. *Francis McDonald,* 254 U.S. 242). A tort is maritime if the injury is inflicted on navigable waters (*Atlantic Transport Co.* v. *Imbrovek,* 234 U.S. 52). If a vessel collides with a pier the damage to the pier is a non-maritime tort because the injury occurs on land (*Cleveland Terminal & Valley R.R. Co.* v. *Cleveland S.S. Co.,* 208 U.S. 316), but the damage to the vessel is a maritime tort because that injury occurs on navigable waters (*P.W. & B.R.R. Co.* v. *Phila. etc. S.S. Co.,* 23 How. 209; *Hill* v. *Board of Freeholders,* 45 Fed. 260). (A. M. B.)

**ADMISSION:** *see* EVIDENCE, also ESTOPPEL.

**ADMITTANCE**, in alternating current electricity, the reciprocal of the reactance. (*See* ELECTRICITY.)

**ADO** (d. 874), archbishop of Vienne in Lotharingia, belonged to a famous Frankish house, and spent much of his middle life in Italy. He held his archiepiscopal see from 859 until his death on Dec. 16, 874. Several of his letters are extant and reveal their writer as an energetic man of wide sympathies and considerable influence.

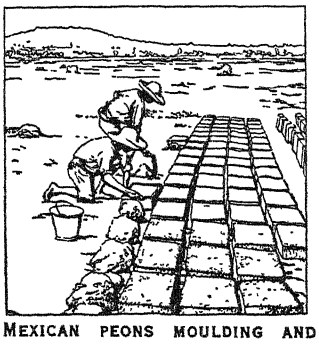
Ado's principal works are a *Martyrologium* (printed *inter al* in Migne, *Patrolog lat.*, cxxiii, pp. 181–420; append., pp. 419–436), and chronicle, *Chronicon sive Breviarium chronicorum de sex mundi aetatibus de Adamo usque ad ann. 869* (in Migne, cxxiii, pp. 20–138 and Pertz, *Monumenta Germ*, ii, pp. 315–323, etc).

Ado's chronicle is based on that of Bede, with which he combines extracts from the ordinary sources, forming the whole into a consecutive narrative founded on the conception of the unity of the Roman empire, which he traces in the succession of the emperors, Charlemagne and his heirs following immediately after Constantine and Irene. "It is," says Wattenbach, "history from the point of view of authority and preconceived opinion, which exclude any independent judgment of events"

Ado also wrote a book on the miracles (*Miracula*) of St Bernard, archbishop of Vienne (9th century), published in the Bollandist *Acta Sanctorum;* a life or *Martyrium* of St. Desiderius, bishop of Vienne (d. 608), written about 870 and published in Migne, cxxiii, pp. 435–442; and a life of St. Theudericus, abbot of Vienne (563), published in Mabillon, *Acta Sanct.*, i, pp. 678–681, Migne, cxxiii, pp 443–450, and revised in Bollandist *Acta Sanct.*, xii, pp. 840–843.

*See* W. Wattenbach, *Deutschlands Geschichtsquellen,* vol. i (Stuttgart, 1904).

**ADOBE** (ą-dō′bę), a Spanish-American word (often corrupted to *dobie*) for the sun-dried clay used for building by the Indians in the arid regions of the southwestern United States and northern Mexico (from Spanish *adobar,* to plaster). The use of such building material is said to have been anciently introduced into Spain from northern Africa. Soon after the discovery of America the method was imported into Peru, Mexico and other dry countries of the new world by the Spanish conquerors, who brought it as early as the 16th century to the Indians of New Mexico and Arizona. Most of the buildings connected with the Spanish missions in California, established in 1770–1823, were constructed of adobe. In Mexico and the southwestern United States the name is not only applied to the bricks but also to the clay from which they are made, and, likewise, to structures built of this material. The usual method of making adobe is very simple. It consists of wetting a quantity of suitable clay, adding a small amount of chopped straw, hay, grass roots or other fibrous litter, mixing the materials with a hoe or a similar implement, and then trampling the mass with the bare feet. When brought to the proper consistency, the adobe is shaped with simple wooden moulds into bricks. These vary greatly in size, in accordance with intended use, ranging from small forms about 8 in. square and 2 in. thick to large slabs 1 or 2 yd. long, 1 ft. wide and 6 to 8 in. thick. A common form for structural use is about 12 in. wide, 16 in. long and from 4 to 8 in. thick. After being properly dried, adobes are laid in walls, like ordinary bricks, and joined with a mortar of the same material. Often the walls are smoothly finished inside and out with this mortar and given an outer coating of lime wash, which is frequently tinted with yellow or other colours.



MEXICAN PEONS MOULDING AND DRYING ADOBE, A COMMON BUILDING MATERIAL IN ARID PARTS OF MEXICO AND THE SOUTHWEST U.S.

In regions of scant rainfall adobe is serviceable in structures of one story, or other low buildings, having well-drained foundations and nonleaking roofs with wide cornices and eaves. When protected against the action of water, adobe walls will endure for many decades and sometimes for centuries. As adobe is a very poor conductor of heat and as walls made of it do not become frosty in cold weather or damp in a short rainy season, adobe structures are warm in winter and cool in summer, the interior temperature of the walls remaining remarkably constant. After 1900 there was a revival of adobe construction in the southwestern United States, particularly in California. In a modified form adobe is utilized also in Colorado and other states of the Rocky Mountain plateau, where, instead of being first made into bricks, the adobe is moulded directly into the wall, being applied and dried in successive layers.

In the plateau region adobe is used chiefly for walls of stables cattle sheds and chicken houses. In southern California substantial city homes have been constructed with adobe walls, made from materials available on the premises, and finished with waterproof plaster or stucco, thus making it possible, when so desired, to dispense with the wide cornices and eaves otherwise required in adobe structures.

Scientific researches have shown that seeds that have been embedded with the barnyard refuse used in making adobe are preserved indefinitely. Consequently, by dissolving out seeds contained in adobes from the walls of old buildings whose date of erection is known, the approximate date of introduction of various cultivated plants in the region may be ascertained.

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**ADOBE SOIL,** a term used in the western United States, particularly in California, to designate the structural quality of various clay soils, referring usually to the characteristic breakage of such soil material into small angular blocks when it dries These soils are very heavy in texture, being composed of extremely fine-grained material, a large part of which is colloidal. Sands and loose sandy loams, for example, never display an adobe soil structure.

By many, however, adobe soils are thought of as constituting the material from which adobe or sun-dried bricks are made; but, as in the case of ordinary brick, adobe building materials are derived from a great variety of clayey soils. Under proper conditions of moisture soils of adobe structure are readily worked, but when too dry their hardness and coherence make tillage extremely difficult. When placed under irrigation, soils of this type usually display great fertility.

**ADOLESCENCE,** the period of human development between childhood and maturity For the psychological aspects of adolescence, *see* PSYCHOLOGY, especially the sections *Clinical Psychology* and *Educational Psychology. See* also SECONDARY EDUCATION, for the relation between adolescence and education, and AGE, for the legal aspects of this period, particularly in relation to rights and responsibilities.

**ADOLPH OF NASSAU** (*c.* 1255–1298), German king, son of Walram, count of Nassau. He appears to have received a good education, and inherited his father's lands around Wiesbaden in 1276.

Adolph won considerable fame as a mercenary in many of the feuds of the time, and on May 5, 1292, was chosen German king, in succession to Rudolph I, an election which was due rather to the political conditions of the time than to his personal qualities. He made large promises to his supporters, and was crowned on July 1 at Aix-la-Chapelle. Princes and towns did homage to him, but his position was unstable, and the allegiance of many of the princes, among them Albert I, duke of Austria, son of the former king Rudolph, was merely nominal.

Seeking at once to strengthen the royal position, he claimed Meissen as a vacant fief of the empire, and in 1294 allied himself with Edward I, king of England, against France. Edward granted him a subsidy, but because of a variety of reasons Adolph did not take the field against France, but turned his arms against Thuringia, which he had purchased from the landgrave Albert II.

This bargain was resisted by the sons of Albert, and from 1294 to 1296 Adolph was campaigning in Meissen and Thuringia, and his relations with Albert of Austria were becoming more strained

He had been unable to fulfil the promises made at his election, and the princes began to look with suspicion upon his designs. Wenceslaus II, king of Bohemia, fell away from his allegiance, and his deposition was decided on, and was carried out at Mainz, on May 23, 1298, when Albert of Austria was elected his successor. The forces of the rival kings met at Göllheim on July 2, 1298, where Adolph was killed, it is said by the hand of Albert. He was buried at Rosenthal, and in 1309 his remains were removed to Spires.

BIBLIOGRAPHY.—F. W E Roth, *Geschichte des Römischen Konigs Adolf I von Nassau* (Wiesbaden, 1879); V Domeier, *Die Absetzung Adolfs von Nassau* (Berlin, 1889), L Ennen, *Die Wahl des Königs Adolf von Nassau* (Cologne, 1866), L Schmid, *Die Wahl des Grafen Adolf von Nassau zum Romischen Konig;* B. Gebhardt, *Handbuch der deutschen Geschichte,* Band 1 (Berlin, 1901)

**ADOLPHUS, JOHN LEYCESTER** (1795–1862), English lawyer and author, was the son of John Adolphus (1768–1845), a well-known London barrister who wrote a *History of England to 1783* (1802), a *History of France from 1790* (1803) and other works. He was educated at Merchant Taylors' school and at St. John's college, Oxford

In 1821 he published *Letters to Richard Heber, Esq.,* in which he discussed the authorship of the then anonymous Waverley novels, and fixed it upon Sir Walter Scott. This conclusion was based on the resemblance of the novels in general style and method to the poems acknowledged by Scott. Scott thought at first that the letters were written by Reginald Heber, afterward bishop of Calcutta, and the discovery of J. L Adolphus' identity led to a warm friendship. Adolphus was called to the bar in 1822, and his *Circuiteers, an Eclogue,* is a parody of the style of two of his colleagues on the northern circuit.

He became judge of the Marylebone County court in 1852, and was a bencher of the Inner Temple He was the author of *Letters from Spain in 1856 and 1857* (1858), and at the time of his death on Dec. 24, 1862, was engaged in completing his father's *History of England,* a book still valuable for the history of the first part of the reign of George III.

**ADOLPHUS FREDERICK** (1710–1771), king of Sweden, was born at Gottorp on May 14, 1710. His father was Christian Augustus (1673–1726), duke of Schleswig-Holstein-Gottorp, bishop of Lübeck, and administrator, during the war of 1700–21, of the duchies of Holstein-Gottorp for his nephew Charles Frederick; his mother was Albertina Frederica of Baden-Durlach. From 1727 to 1750 he was bishop of Lübeck, and administrator of Holstein-Kiel during the minority of Duke Charles Peter Ulrich, afterward Peter III of Russia.

In 1743 he was elected heir to the throne of Sweden by the "Hat" faction in order that they might obtain better conditions of peace from the empress Elizabeth, whose fondness for the house of Holstein was notorious.

During his whole reign (1751–71) Adolphus Frederick was little more than a state decoration, the real power being lodged in the hands of an omnipotent *riksdag,* distracted by fierce party strife. Twice he endeavoured to free himself from the intolerable tutelage of the estates.

The first occasion was in 1756 when, stimulated by his imperious consort Louisa Ulrica, sister of Frederick the Great, he tried to regain a portion of the attenuated prerogative, and nearly lost his throne in consequence. On the second occasion, under the guidance of his eldest son, the crown prince Gustavus, afterward Gustavus III, he succeeded in overthrowing the tyrannous "Cap" senate, but was unable to make any use of his victory. He died at Stockholm on Feb. 12, 1771.

*See* R. Nisbet Bain, *Gustavus III and his Contemporaries,* vol. i (London, 1895).

**ADONI,** a town of former British India, in the Bellary district of Madras, 307 mi. from Madras by rail. Pop. (1941) 35,431. It has manufactures of carpets, silk and cotton goods, factories for ginning and pressing cotton and a considerable trade in cotton. The hill fort above, now in ruins, was a seat of government frequently mentioned in 18th-century wars.

**ADONIJAH** (Heb. *Adoniyyah* or *Adoniyyahu,* "Yah is Lord"), a name borne by several persons in the Old Testament, of whom the most noteworthy was the fourth son of David. He was born to Haggith at Hebron (II Sam iii, 4; I Ch. iii, 2) Adonijah was the natural heir to the throne. On the death of Absalom, and shortly before the death of David, he made preparations to seize his birthright, in which he received the support of Joab and Abiathar the priest; he also made arrangements for his coronation (I Kings i, 5 *et seq* ).

However, Bathsheba, David's favourite wife, organized a counterintrigue in favour of her son Solomon. With the help of Bathsheba and of Nathan the prophet, and apparently with the consent of David, Solomon ascended the throne. Hearing this, Adonijah fled for safety to the horns of the altar Solomon spared him on this occasion (I Kings i, 50 *et seq* ), but later he commanded Benaiah to slay Adonijah ( ii, 13 *et seq* ) on the ground that he wished, with the approval of Bathsheba, to marry David's former concubine, Abishag, and thus seemed to be aiming at the crown (I Kings i, *et seq.*).

**ADONIS,** in classical mythology, a youth of remarkable beauty, the favourite of Aphrodite. According to the story in Apollodorus (iii, 14, 4), he was the son of the Syrian king Theias by his daughter Smyrna (Myrrha), who had been inspired by Aphrodite with unnatural love. When Theias discovered the truth he would have slain his daughter, but the gods in pity changed her into a tree of the same name. After ten months the tree burst asunder and from it came forth Adonis. Aphrodite, charmed by his beauty, hid the infant in a box and handed him over to the care of Persephone, who afterward refused to give him up. On an appeal being made to Zeus, he decided that Adonis should spend a third of the year with Persephone and a third with Aphrodite, the remaining third being at his own disposal.

There are many variations in the later forms of the story, notably the version given by Ovid (*Metam.,* x, 298) which is also the one used by Shakespeare. In this version, Adonis was killed by a boar. Apollodorus (iii, 185) clumsily combines the two The name is generally supposed to be of Phoenician origin (from *adon,* "lord"), Adonis himself being identified with Tammuz (but *see* F. Dummler in Pauly-Wissowa's *Real-encyklopädie,* who does not admit a Semitic origin for either name or cult). The name Abobas, by which he was known at Perga in Pamphylia, certainly seems connected with *abub* (a Semitic word for "flute"; *cf* "ambubaiarum collegia" in Horace, *Satires,* i, 2, I). (*See* also ATTIS.)

Annual festivals, called Adonia, were held in his honour at Byblus, and also, from the 5th century B.C. onward, at different places in Greece. Although there were variations in the ceremony itself and in its date, the central idea was the death and resurrection of Adonis, mourning for Adonis who was generally represented by an effigy which was afterward thrown into the water. A vivid description of the very elaborate festival at Alexandria (for which Bion probably wrote his *Dirge of Adonis*) is given by Theocritus in his 15th idyll, the *Adoniazusae.* On the first day, which celebrated the union of Adonis and Aphrodite, their images were placed side by side on a silver couch, around them all the fruits of the season, "Adonis gardens" in silver baskets, golden boxes of myrrh, cakes of meal, honey and oil, made in the likeness of things that creep and things that fly. On the day following, the image of Adonis was carried down to the shore and cast into the sea by women with dishevelled hair and bared breasts. At the same time a song was sung, in which the god was entreated to be propitious in the coming year.

This festival, like that at Athens, was held late in summer; at Byblus, where the mourning ceremony preceded, it took place in spring.

It later became generally agreed by most authorities that Adonis represents a vegetation spirit, whose death and later return to life represent the decay of nature in winter and its revival in spring. He is born from the myrrh tree, the oil of which is used at his festival. He is connected with Aphrodite in her character of vegetation goddess. A special feature of the Athenian festival was the "Adonis gardens," small pots of seeds forced

to grow artificially, which rapidly faded. The dispute between Aphrodite and Persephone for the possession of Adonis finds a parallel in the story of Tammuz and Ishtar (*see* APHRODITE). In other words, Aphrodite is the Oriental mother-goddess, Adonis her lover; the details have been influenced by the legend of Demeter (*q.v.*). The ceremony of the Adonia was intended as a charm to promote the growth of vegetation, the throwing of the gardens and images into the water being supposed to procure a supply of rain (for European parallels *see* Mannhardt). It is suggested (Frazer) that Adonis is not a god of vegetation generally, but specially a corn-spirit, and that the lamentation is not for the decay of vegetation in winter, but for the cruel treatment of the corn by the reaper and miller (*cf.* Robert Burns's *John Barleycorn*).



ADONIS, A YOUTH IN CLASSICAL MYTHOLOGY, BELOVED BY APHRODITE FOR HIS GREAT BEAUTY

An important element in the story is the connection of Adonis with the boar; possibly Adonis himself was looked upon as incarnate in the swine. For a god sacrificed to himself as his own enemy, *cf.* the sacrifice of the goat and bull to Dionysus. It has been observed that whenever sacrifices of swine occur in the ritual of Aphrodite there is reference to Adonis. In any case, the conception of Adonis as a swine-god does not contradict the idea of him as a vegetation or corn spirit, which in many parts of Europe appears in the form of a boar or sow.

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**ADONIS,** a genus of plants of the crowfoot family (Ranunculaceae, *q.v.*) known as pheasant's eye and *Flos Adonis*. They comprise about 20 Eurasian species, cultivated for ornament. They are erect herbs with much-divided leaves and yellow or red flowers. *Adonis vernalis* is a perennial, but *A. aestivalis* and *A. annua* are annuals, the latter sometimes naturalized. The name is also given to the Adonis Blue butterfly (*Lysandra bellargus*), occurring in the chalk downs of southern England.

**ADOPTION** is the act of a person taking upon himself the position of parent to another who is not in fact or is not treated by law as his child, and the person so acting is recognized by the law as having the rights and duties of a parent by nature. The practice prevailed in most civilized or semicivilized nations from the earliest times. In India it is general, based on customs or religious and social ideas which vary in different parts of the country and among different classes. "The probability is that any Hindu who has no son will contemplate adoption," and the effect that every adoption must have on the devolution of property causes endless disputes, so that the courts, including the privy council on appeals from Indian tribunals, are constantly occupied with the litigation of this subject. An elaborate statement with regard to the Indian laws affecting adoption will be found in Z. Mayne's *Commentaries*.

Adoption was also common among the Greeks and Romans. The Roman law was well defined and clearly stated by the jurists and, in this as well as in other subjects, had an important influence on the law of most modern European countries except England. Important changes were made from time to time, but it is to be noticed that from the earliest to the latest times some intervention on the part of the state and official sanction was required to give legal effect to adoptions. This principle has been generally accepted in the legislation and practice of modern states and is also the basis of the recent change in English law.

By the French code conditions are laid down under which adoption may take place. To give legal effect to it, enquiry must be made by the court (1) whether the conditions have been fulfilled, (2) whether the adopter is of good repute. The act of adoption must be published and registered The adopted person preserves his rights in his natural family of origin and gains no rights of inheritance as regards the property of the relatives of the adopter, but in the property of the adopter himself has the same rights as a legitimate child. According to the French code, the adoptive parent must be 50 years of age, and on the other hand it is provided that *l'adoption ne pourra en aucun cas avoir lieu avant la majorité de l'adopté.* A subsequent part of the code deals with the appointment of *tuteurs officieux* for protection of the interests of persons who require such oversight or assistance.

In Germany adoption is recognized and plays a most important part in the social life and conditions of the German people. It is regulated by a number of elaborate and carefully drawn provisions which are contained in the civil code. A comprehensive statement of these provisions will be found in an article by Henry Happold, of Berlin, which appeared in the *Law Magazine and Review* for Aug. 1914. It shows how complicated the question is and how many points have to be provided for. As in the French code, confirmation by a competent tribunal is necessary to give legal validity to an adoption. It is also to be noted that though the adopted child acquires the legal position of a legitimate child of the adopter, the adopter acquires no right of inheritance, and the person adopted acquires no rights as regards the relatives of the adopter

Adoption is also provided for in the legislation of the British dominions In West Australia, for example, a male may be adopted by a man 18 years his senior, or by a woman 30 years his senior, or a female by a woman 18 years her senior or a man 30 years her senior. An act on the subject has also been passed in South Africa.

In view of this widespread recognition of adoption by law both in ancient and modern states all over the world it seems strange that until 1926 "adoption" in the sense of the transfer of parental rights and duties in respect of a child to another person and their assumption by him was not recognized by the law of England (*see* Halsbury's *Commentaries*). But a relative or a stranger might put himself *in loco parentis* to a child, and certain legal consequences between the parties might result from that position Where a parent has neglected a child or it would be injurious to the child to remain in his custody, he could be deprived of it or of the direction of the child's education or of the right to decide in what religion it shall be brought up (*re Newton*, 1896, 1 ch., 748). Under the Children act, 1908, and other statutes the guardianship of children may be taken from parents who have ill-treated and neglected them and entrusted to some other person or institution, but this is not properly a case of adoption.

By the British Adoption of Children act, 1926, for the first time a definite system of legal adoption is introduced. Under that act on application made by a person desirous of being authorized to adopt an infant, the court may make an order authorizing the applicant to adopt that infant. In this procedure English law follows the precedent of Roman law and of most other countries, including the dominions, in requiring the sanction of a judicial or public authority for adoption of children. The welfare of the child is to be the paramount consideration. No payment or reward is to be received by the adoptive parent unless sanctioned by the court for some special reason. The adopted child does not lose rights of succession to the property of the natural parent or gain rights of succession to the adopter, but all rights and duties of parents or guardians as to future custody, maintenance and education are to vest in and be exercisable by and enforceable against the adopter as though the adopted child was born to the adopter in lawful wedlock. The applicant must not be under 25 years of age, must as a rule be 21 years older than the person adopted, and the court must see that the consent of the proper parties has been obtained. Either the high court, the county courts or courts of summary jurisdiction may deal with

applications for adoption, and the effect of the order is registered

Already the act has been used in a very large number of cases, and it is constantly found that between the adoptive parents and the children adopted ties of affection grow up very similar to those which exist between parents and their own children.

In the United States, Louisiana and Texas follow the civil law in relation to adoption, but the other states, where their jurisprudence is based on the common law, have had to enact statutes concerning the same. In many states it is required that adoptions be made only by married couples, but in a few states a single person may do so. Suitable age, financial solvency and substantial compliance with the requirements of the statutes are essential to make adoptions legal. Some states permit adoptions only of minors, and others forbid adoptions of relatives. An adopted child stands in the position of a child by blood in the matter of inheritances if the adoptive parent dies intestate.

*See* W. Clarke Hall, *Law of Adoption and Guardianship of Infants* (1928). (A. H)

**ADOPTIONISM.** As the theological doctrine of the Logos which bulks so largely in the writings of the apologists of the 2nd century came to the front, the trinitarian problem became acute. The necessity of a constant protest against polytheism led to a tenacious insistence on the divine unity, and the task was to reconcile this unity with the deity of Jesus Christ. Some thinkers fell back on the "modalistic" solution which regards "Father" and "Son" as two aspects of the same divine principle; but the "adoptionist" or humanitarian method was a simpler and more popular one. Basing their views on the synoptic Gospels the adoptionists under Theodotus of Byzantium tried to found a school at Rome *c.* 185, asserting that Jesus was a man, imbued with the Holy Spirit's inspiration from his baptism, and so attaining such a perfection of holiness that he was adopted by God and exalted to divine dignity. Theodotus was excommunicated by the bishop of Rome, Victor, *c.* 195, but his followers lived on under a younger teacher, Artemon, while in the east similar views were expounded by Beryllus of Bostra and Paul of Samosata, who undoubtedly influenced Lucian of Antioch and his school, including Arius and, later, Nestorius.

There is thus a traceable historical connection between the early adoption controversy and the struggle in Spain at the end of the 8th century, to which that name is usually given. It was indeed only a renewal, under new conditions, of the conflict between two types of thought, the rational and the mystical, the school of Antioch and that of Alexandria. The writings of Theodore of Mopsuestia, a typical representative of the Antiochene school, had become well known in the west, and the opposition of Islam also partly determined the form of men's views on the doctrine of Christ's person. About 780 Elipandus (born 718), archbishop of Toledo, revived and vehemently defended the expression, *Christus Filius Dei adoptivus* (Christ the adopted son of God), and was aided by his much more gifted friend Felix, bishop of Urgella. They held that the duality of natures implied a distinction between two modes of sonship in Christ—the natural or proper, and the adoptive. In support of their views they appealed to scripture, and especially to Christ's fraternal relation to Christians—the brother of God's adopted sons. Christ, the firstborn among many brethren, had a natural birth at Bethlehem and also a spiritual birth begun at his baptism and consummated at his resurrection. Thus they did not teach a dual *personality*, nor the old Antiochene view that Christ's divine exaltation was due to his sinless virtue; they were less concerned with old disputes than with the problem as the Chalcedon decision had left it—the relation of Christ's one personality to his two natures.

Felix introduced adoption views into that part of Spain which belong to the Franks, and Charlemagne thought it necessary to assemble a synod at Regensburg (Ratisbon) in 792, before which the bishop was summoned to explain and justify the new doctrine. He renounced it and confirmed his renunciation by a solemn oath to Pope Adrian, to whom the synod sent him. The recantation was probably insincere, for on returning to his diocese he taught adoptionism as before. Another synod was held at Frankfurt in 794, by which the new doctrine was again formally condemned, though neither Felix nor any of his followers appeared.

In this synod Alcuin of York took part. A friendly letter from Alcuin, and a controversial pamphlet, to which Felix replied, were followed by the sending of several commissions of clergy to Spain to endeavour to put down the heresy. Archbishop Leidrad (died 816) of Lyons, being on one of these commissions, persuaded Felix to appear before a synod at Aix-la-Chapelle in 799. There, after six days' disputing with Alcuin, he again recanted his heresy. The rest of his life was spent under the supervision of the Archbishop at Lyons, where he died in 816. Elipandus, secure in his see at Toledo, never swerved from the adoption views, which, however, were almost universally abandoned after the two leaders died. Adoptionism continued to be a source of theological dispute all through the middle ages, but was no longer put forward as a serious interpretation of the person of Christ.

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**ADOR, GUSTAVE** (1845–1928), Swiss statesman, was born at Geneva, Dec. 23, 1845, of a Vaudois family established there in 1814. He studied law at the academy and in 1868 became an advocate. He served his apprenticeship to politics in the cantonal government and was president of the cantonal executive in 1892 and 1906. From 1889 to 1917 he was a member of the Swiss National council, of which he was president in 1901.

Ador gained an international reputation for the hard and disinterested work he did for the International Red Cross. He had become president of the committee four years before World War I, and when it broke out he founded an association at Geneva for facilitating communications between prisoners of war and their families and for alleviating their condition. A central agency for forwarding parcels and letters was established.

In June 1917, after the enforced resignation of Arthur Hoffmann, Ador became a member of the executive of the Swiss federation with the portfolio of foreign affairs. Toward the end of 1918 he was elected president of the Swiss federation; he retired at the end of his year of office. He headed the Swiss delegation which visited Paris and London in Jan.-Feb. 1920 to secure a reservation of the principle of the neutrality of Switzerland when she joined the League of Nations. He did important work for the League itself, first as president of the Brussels Conference of 1920 and then as president of the Economic and Financial commission. He represented Switzerland at the various assemblies of the League of Nations until 1924, when he retired on the ground of advancing age, although he still continued his Red Cross work. He died at Geneva on March 31, 1928. His funeral was a national ceremony, and was held in Geneva cathedral.

**ADORATION,** from the phrase (*manum*) *ad os* (*mittere*) which designated the Roman's act of kissing the hand to the statue of the god he wished to honour, has come to denote the act whereby man acknowledges God's supreme perfection and dominion. Such actions are principally sacrifice and the prayer of praise which of their very nature are restricted to the adoration of God. The Greek Christians distinguished carefully between λατρεία, the worship of God, and προσκύνησις, the veneration given to other sacred persons or objects. Both Greek words were translated into Latin by the one word *adoratio*, and as a result the distinction of concepts was at times obscured. In English this confusion has been avoided by the more common use of *veneration* to designate the reverence paid to Saints and images or relics of Saints. Roman Catholics add a further distinction between such veneration as paid to the Blessed Virgin because of her singular pre-eminence (*hyperdulia*) and as paid to Saints and sacred objects (*dulia*). By a natural transition *adoration* has also been applied to the homage rendered to monarchs by the ceremony of striking the earth with the forehead.

**ADORF,** a town in the *Land* of Saxony, 3 mi. from the Czechoslovakian frontier, at a height of 1,400 ft. above sea. Pop. (1933) 7,886. Musical instruments, objects in mother of pearl, textiles and carpets are made.

ADOUR, a river of south-west France, rising in the department of Hautes Pyrénées, south of the Pic du Midi de Bigorre, and flowing in a wide curve to the Bay of Biscay. It traverses the beautiful valley of Campan and, after passing Bagnères de Bigorre, enters the plain of Tarbes Beyond Tarbes numerous canals are drawn from the river for irrigation purposes; the most important is the Canal d'Alaric, which follows the right bank for 36 mi. Within the department of Landes it flows west and later south-west, becoming navigable at St. Sever, beyond which it is joined on the left by the Larcis, Gabas, Louts and Luy, and on the right by the Midouze. After Bayonne the river enters the sea through a dangerous estuary, after a total course of 208 mi The mouth of the Adour has repeatedly shifted, its old bed being represented by the series of *étangs* and lagoons extending northward as far as the village of Vieux Boucau (22½ mi.), where it debouched in the 14th century. The present channel was constructed by the engineer Louis de Foix in 1579. The area of the basin of the Adour is 6,565 sq.mi.

**ADRA** (anc. *Abdera*), a seaport of S. Spain, in Almería province. Pop. (1940) 6,907 (mun., 12,443). Adra is the port of shipment for the lead obtained in the Sierra de Gádor near Berja, 10 mi. N E., and also exports grapes, sugar and esparto grass.

**ADRAR** (Berber for "uplands"), the name of various districts of the Sahara, northern Africa. Adrar Sutuf is a hilly region in southern Rio de Oro (*q.v.*). Adrar el Jebli, otherwise Adghagh, a plateau north-east of Timbuktu, is the headquarters of the Awellimiden Tuareg (see TUAREG and SAHARA). Adrar n'Ahnet and Adrar Adhafar are smaller regions in the Ahnet country south of Insalah. Adrar Temur, the best known region of the name, is in the western Sahara, 300 mi. N. by E. of the Senegal and separated on the north-west from Adrar Sutuf by wide valleys and sand dunes. Adrar is within the French sphere of influence. In general barren, the country, which occupies the centre of a plateau scarped steeply westwards, contains several oases, with a total population of about 10,000. The chief centres of population are Atar, Shingeti, Wadan and Ujeft, Shingeti being the chief commercial centre, whence caravans take to St. Louis gold-dust, ostrich feathers and dates. A considerable trade is also done in salt from the sebkha of Ijil, in the north-west.

Adrar or Adgar is also the name sometimes given to the chief settlement in the oasis of Tuat in the Algerian Sahara.

**ADRASTUS:** *see* OEDIPUS.

**ADRENAL GLANDS.** These consist of two parts. The inner portion, the medulla, produces epinephrine—also known as adrenaline. The outer portion, the cortex, elaborates cortisone, hydrocortisone and at least one other hormone which is probably a steroid, and is concerned with mineral metabolism. About 25 other steroids are present in the adrenal cortex but they have little or no physiologic activity and are apparently intermediate steps in the elaboration of cortisone and hydrocortisone.

Epinephrine when administered mimics the action produced by stimulation of the sympathetic nervous system and fortifies the body in an emergency—Cannon's theory. Among these effects are a rapid rise in blood pressure, an increase in the concentration of blood sugar and the flow of blood to the muscles, and inhibition of digestion. However, the adrenal medulla is not essential for life. Activity of the medulla is controlled largely by stimulation of sympathetic nerves and by humoral agents such as acetylcholine and insulin.

The physiologic activity of the cortical hormones can be summarized under three aspects. First, mineral metabolism: the maintenance within narrow limits of the concentration in the blood of sodium potassium and chloride is essential for life. The secretions of the adrenal cortex exert an important influence on this phenomenon. The hormone (or hormones) which produces this effect had not been isolated at mid-20th century. Second, organic metabolism: the utilization and distribution of carbohydrates, proteins and fats are modified by cortisone and hydrocortisone. Third, tissue reactions such as hypersensitivity, allergic states and collagen diseases: the beneficial results produced by cortisone and hydrocortisone are manifested in the relief of rheumatoid arthritis and about 20 other diseases. The adrenal cortex does not appear to be directly involved in the aetiology of any of these diseases, and the manner in which cortisone and hydrocortisone produce their effect is not known. The activity of the adrenal cortex is controlled by the pituitary gland through an agent designated as adrenocorticotropic hormone or ACTH

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(E. C KL)

ADRENALIN (EPINEPHRINE) is one of the active principles of the medulla of the suprarenal gland It produces effects similar to those resulting from stimulation of the sympathetic nervous system and is thought to be similar to, if not identical with, the substance sympathin liberated at the terminations of the sympathetic nerves. It is used in circulatory emergencies and in treatment of asthmatic paroxysms and anaphylactoid reactions. Added to local anaesthetic solutions, it increases the duration of anaesthesia and decreases systemic toxicity by reducing absorption through local vasoconstriction (*See* ADRENAL GLANDS).

(F. L. A.)

**ADRIA** (anc. *Atria*), the form Adria or Hadria is less correct. Atria was a town in Picenum, the modern Atri, town and episcopal see, province of Rovigo, Italy, 15 mi E by rail from the town of Rovigo. It is situated between the mouths of the Adige and the Po, about 13½ mi from the sea and but 13 ft. above it. Pop. (1936), 9,435 (town), 32,762 (commune). It gave its name to the Adriatic and was an important Etruscan harbour. The town was famous in Aristotle's day for a special breed of fowls. Even then river silt rendered access difficult, and the historian Philistus excavated a canal to the sea. This was still open in the imperial period, and the town possessed its own guild of sailors; but its importance gradually decreased. The remains of the ancient town lie 10–20 ft. below the modern level.

**ADRIAN** or **HADRIAN** (Lat. *Hadrianus*), the name of six popes.

ADRIAN I., pope from 772 to 795, was the son of Theodore, a Roman nobleman. Soon after his accession Adrian found it necessary to invoke the aid of Charlemagne against Desiderius, king of the Lombards. In his contest with the Greek empire and the Lombard princes of Benevento, Adrian remained faithful to the Frankish alliance, and the friendly relations between pope and emperor were not disturbed by the difference which arose between them on the question of veneration of images, to which Charlemagne and the Gallican Church were strongly opposed, while Adrian approved the decree of the council of Nicaea (787), confirming the practice and excommunicating the iconoclasts. The dispute remained unsettled at Adrian's death. Adrian restored the ancient aqueducts of Rome, and governed his little state with a firm and skilful hand.

ADRIAN II., pope from 867 to 872, was a member of a noble Roman family, and became pope in 867, at an advanced age. Like his predecessor, Nicholas, Adrian II. was forced to submit, at least in temporal affairs, to the tutelage of the emperor, Louis II., who placed him under the surveillance of Arsenius, bishop of Orta, his confidential adviser, and Arsenius's son Anastasius, the librarian. Adrian had married in his youth, and his wife and daughter were still living. They were carried off and assassinated by Anastasius's brother, Eleutherius. Adrian died in 872.

ADRIAN III., pope, was born at Rome He succeeded Martin II. in 884, and died in 885, on a journey to Worms.

ADRIAN IV. (Nicholas Breakspear), pope from 1154 to 1159, the only Englishman who has occupied the papal chair, was born before A.D. 1100 at Langley, near St. Albans, in Hertfordshire. Nicholas went to Paris and became a monk of the cloister of St. Rufus, near Arles. He rose to be prior, and in 1137 was unanimously elected abbot. Eugenius III. created him cardinal bishop of Albano. From 1152 to 1154 Nicholas was in Scandinavia as legate, organizing the affairs of the new Norwegian archbishopric of Trondhjem, and arranging for the recognition of Uppsala as a metropolitan see in 1164. Nicholas was elected pope on Dec. 4, 1154. He at once endeavoured to compass the overthrow of Arnold of Brescia, the leader of anti-papal sentiment in Rome,

Disorders ending with the murder of a cardinal led Adrian, shortly before Palm Sunday 1155, to put Rome under the interdict. The senate thereupon exiled Arnold, and the pope, with the co-operation of Frederick I. Barbarossa, was instrumental in procuring his execution. Adrian crowned the emperor at St. Peter's on June 18, 1155, a ceremony which so incensed the Romans that the pope had to leave the city for some months. At the diet of Besançon in Oct. 1157, the legates presented to Barbarossa a letter from Adrian which alluded to the *beneficia* conferred upon the emperor, and the German chancellor translated this *beneficia* in the feudal sense. In the storm which ensued the legates were glad to escape with their lives, and the incident at length closed with a letter from the pope, declaring that by *beneficium* he meant merely *bonum factum.* The breach subsequently widened, and Adrian was about to excommunicate the emperor when he died at Anagnia on Sept. 1, 1159

In 1155 Henry II. of England sent an embassy to Adrian to ask for permission to invade and subjugate Ireland, in order to gain absolute ownership of that isle. Unwilling to grant a request counter to the papal claim (based on the forged Donation of Constantine) to dominion over the islands of the sea, Adrian proposed that the king should become hereditary feudal possessor of Ireland while recognizing the pope as overlord. This compromise did not satisfy Henry, so the matter dropped; Henry's subsequent title to Ireland rested on conquest, not on papal concession, and was therefore absolute. The much-discussed bull *Laudabiliter* is, however, not genuine.

*See* Herzog-Hauck, *Realencyklopädie,* 3rd ed (excellent bibliography), and Wetzer and Welte, *Kirchenlexikon,* 2nd ed. under "Hadrian IV"; also Oliver J. Thatcher, *Studies concerning Adrian IV* (Chicago, 1903); R. Raby, *Pope Adrian IV; An Historical Sketch* (London, 1849); and A. H. Tarleton, *Life of Nicholas Breakspear* (London, 1896).

ADRIAN V. (Ottobuono de' Fieschi), pope in 1276, was a Genoese who was created cardinal deacon by his uncle Innocent IV. In 1264 he was sent to England to mediate between Henry III. and his barons. He was elected pope to succeed Innocent V. on July 11, 1276, but died at Viterbo on Aug. 18, without having been ordained even to the priesthood.

ADRIAN VI. (Adrian Dedel, not Boyens, probably not Rodenburgh, 1459–1523), pope from 1522 to 1523, was born at Utrecht in March 1459, and became tutor to the seven-year-old Charles V. Charles secured his succession to the see of Tortosa, and on Nov. 14, 1516, commissioned him inquisitor-general of Aragon. During the minority of Charles, Adrian was associated with Cardinal Ximenes in governing Spain. After the death of the latter Adrian was appointed, on March 14, 1518, general of the reunited inquisitions of Castile and Aragon, in which capacity he acted until his departure from Tarragona for Rome on Aug. 4, 1522. When Charles left for the Netherlands in 1520 he made Adrian regent of Spain. In 1517 Leo X. had created him cardinal priest *SS. Ioannis et Pauli;* on Jan. 9, 1522, he was almost unanimously elected pope. Crowned in St. Peter's on Aug. 31, at the age of 63, he entered upon the lonely path of the reformer. His programme was to attack notorious abuses one by one; but in his attempt to improve the system of granting indulgences he was hampered by his cardinals; reduction of the number of matrimonial dispensations was impossible, for the income had been farmed out for years in advance by Leo X. In dealing with the early stages of the Protestant revolt in Germany Adrian did not fully recognize the gravity of the situation. At the diet which opened in Dec. 1522 at Nuremberg he was represented by Chieregati, whose instructions contain the frank admission that the whole disorder of the church had perchance proceeded from the Curia itself, and that there the reform should begin. But Adrian was stoutly opposed to doctrinal changes, and demanded the punishment of Luther for heresy. The statement in one of his works that the pope could err in matters of faith (*"haeresim per suam determinationem aut Decretalem asserendo"*) has attracted attention; but as it is a private opinion, not an *ex cathedra* pronouncement, it is held not to prejudice the dogma of papal infallibility. On Sept. 14, 1523, he died, after a pontificate too short to be effective.

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**ADRIAN, SAINT,** one of the praetorian guards of the Emperor Galerius Maximian, who, becoming a convert to Christianity, was martyred at Nicomedia on March 4, 303. His limbs were struck off on an anvil, and he was then beheaded. St. Adrian's festival, with that of his wife, St. Natalia, is kept on Sept. 8. He is specially a patron of soldiers, and is much reverenced in Flanders, Germany and the north of France.

**ADRIAN,** a city in southeastern Michigan, U.S., about 32 mi. N.W. of Toledo, on federal highway 223. It is the county seat of Lenawee county, and is served by the New York Central, the Wabash and the Detroit, Toledo and Ironton railways. The population was 18,402 in 1950, 14,230 in 1940 and 13,064 in 1930 (federal census).

The county, a rich farming land, contains beautiful lakes. Adrian's trade in grain, livestock and dairy products is extensive.

Main manufactures include automobile parts, aluminum and brass products, aircraft parts, chrome plating, drills, laboratory and hospital furniture, wood products, machine tools, coil springs, concrete block machinery and milk products.

Educational institutions include Adrian college, a Methodist school established in 1859, and Siena Heights college, a Catholic institution for girls. The State Girls Training school is located in the city.

Adrian was laid out in 1828; incorporated as a village in 1836; became the county seat in 1838; and was chartered as a city in 1853. Tradition says that it was named after the emperor Hadrian.

**ADRIANI, GIOVANNI BATTISTA** (1513–1579), Italian historian, was born of a patrician family of Florence. At the instance of Cosimo I he wrote *Istoria de' suoi tempi* (1583; modern ed. 1872), covering the years 1536 to 1574.

*See* G. M. Mazzucchelli, *Gli Scrittori d'Italia,* i, p. 151 (1753); G. Mondaini, *La storia dei suoi tempi di G. B. Adriani* (Tôrino, 1905).

**ADRIANOPLE** or EDIRNE, the capital of the vilayet of Adrianople, Turkey, 137 mi. by rail W.N.W. of Constantinople. It occupies both banks of the river Tunja, at its confluence with the Maritsa, which is navigable to this point in spring and winter. The nearest seaport by rail is Dédéagatch, west of the Maritsa; Enos, at the river-mouth, is the nearest by water. Adrianople is on the railway from Belgrade and Sofia to Constantinople and Salonica. In appearance it is thoroughly oriental—a mass of mean, irregular wooden buildings, threaded by narrow tortuous streets, with a few better buildings. Earlier buildings include Eski Serai, a half-ruined palace of the sultans; the bazaar of Ali Pasha; and the fine 16th century mosque of the sultan Selim II., built by Sinan.

The war of 1877–78 impoverished Adrianople, and the creation of a customs cordon between it and Eastern Rumelia (1885) put an end to its commercial headship of Thrace, and parts of Bulgaria and Philippopolis and Burgas took most of its trade. The city manufactures silk, leather, tapestry, woollens, linen, and cotton, and has an active general trade. Besides fruits and agricultural produce, its exports include raw silk, cotton, opium, rose-water, attar of roses, wax, and the dye known as turkey red. The surrounding country is extremely fertile, and its wines are the best produced in Turkey. The city is supplied with fresh water by means of an aqueduct carried by arches over an extensive valley. There is also a fine stone bridge over the Tunja.

Adrianople was originally known as Uskadama or Uskodama, but was renamed and enlarged by the Roman emperor Hadrian

(117–138). In 378 the Romans were here defeated by the Goths. Adrianople was the residence of the Turkish sultans from 1361, when it was captured by Murad I., until 1453, when Constantinople fell. It was occupied by the Russians in 1829 and 1878 (*see* RUSSO-TURKISH WARS).

During the first Balkan War Adrianople was taken from the Turks by Bulgars, with Serbian assistance, in 1913, after a siege of 155 days. During the second Balkan War, in June, 1913, the Turks retook the town and, by the Treaty of Constantinople, signed on Sept. 29, 1913, it was ceded, together with Karagatch, to Turkey by Bulgaria. After World War I, the Greek army commissioned to restore order in Thrace (May 1920), entered Adrianople in July, and it was ceded to them (Aug. 10, 1920) by the Treaty of Sèvres. During the Graeco-Turkish War of 1923 the Greeks occupied Karagatch, the railway station of which is very important for the traffic of Dédéagatch and had therefore been abandoned by Turkey to Bulgaria in 1915. On leaving it they destroyed many buildings and removed the machinery from the mills. After the close of World War I Adrianople was again restored to Turkey by the Mudania Convention of October 1922, confirmed by the Treaty of Lausanne of July 24, 1923. A protocol subjected the Greek inhabitants of Karagatch to the exchange of populations, compelling them to emigrate six months after the re-establishment of peace.

The population in 1940 was given as only 45,680, as compared with about 80,000 in 1905 and 65,454 in 1911. This diminution was due to the emigration of the population, with the exception of the Jews, after the successive occupations of the city. The south-western portion of the city, burnt down in 1905, was rebuilt with comparatively broad streets The railway station, which stands among ruins, has been rebuilt.

See *British and Foreign State Papers*, 1914, part 1. vol. cvii, p. 706 (1920); vol. cxiii., p. 652 (1917–23); *Treaty Series*, No. 16 (1923).

**Adrianople, Battle of, 378.**—This is one of the milestones of military, and, in less degree, of political history, for the Roman Empire's barriers against the barbarians were breached so gravely that temporary repair was effected only by the substitution of the forces of destruction—the Goths and Teutons—for the regular imperial forces, and it also marks the changing relative values of infantry and cavalry.

The Visigoths were allowed in 376 to move inside the Roman border to escape the pressure of the Huns. A year later they revolted, and in 378 the Emperor Valens (*q.v.*) determined to subdue them. When (Aug. 9) the attack was made the main body of the Gothic cavalry was away foraging; Gothic offers of surrender, made to regain time for their recall, failed; the Romans, with the legions in the centre, and the cavalry on the wings as customarily, assaulted the Goths' position around the great wagon-laager, when suddenly the enemy squadrons appeared on the scene and charged "like a thunder-bolt" against their left flank. The Roman cavalry were swept aside, while the Gothic horse drove the left wing infantry in upon the centre and reserve, the pressure forcing the Romans into a disordered mass which was too dense to allow them to use their weapons. Surrounded on all sides and forsaken by their right wing cavalry and foot, the Roman main body was massacred, and only after two-thirds of the army had fallen could the survivors break through and follow the retreat of the right wing.

That evening the sun set for all time on the glory of the legions, the infantry who had been the foundation of Roman world-power, and a thousand years' era of cavalry supremacy was ushered in. Henceforth cavalry became the predominant arm of the Roman army, as reorganized by Theodosius, and 150 years later, during Justinian's revival of Roman power, we find Belisarius risking battle and achieving victory without waiting for his infantry to arrive on the battlefield. (*See* ROMAN ARMY.)

**ADRIATIC SEA** (ancient *Adria* or *Hadria*), an arm of the Mediterranean sea separating Italy from the Balkan peninsula, occupying a structural depression between the New Fold mountain systems of the Apennines and the Dinaric Alps. The sea extends from north-west to south-east between lat. 40° and 45° 45′ N., a length of nearly 500 miles. Its average width is *c.* 110m.; but the Strait of Otranto is only 45 miles. The Italian shore, except where the Apennines fall steeply to a narrow coastal ledge between Rimini and Mt Gargano, is low, merging in the north-west into the marshes and lagoons about the delta of the Po, the basin of which is structurally a continuation of the Adriatic. The sediment brought by the river has pushed forward the coast-line for several miles within historic times. The east coast is generally rugged, and south of the Istrian peninsula, placed between the Gulf of Trieste and the Strait of Quarnero, is fringed with islands (*e.g.*, Veglia, Cherso, Brazza and Curzola) and with many small islets and rocks which represent submerged parallel deviations of the longitudinal mountain folds. Opposite the islands of the Dalmatian coast the sea is shallow, and in the extreme north rarely exceeds 25 fathoms. But between Sebenico and the Abruzzi a well marked depression occurs, with depths exceeding 100 fathoms. South of this shallower water continues, but beyond Mt Gargano and south of Ragusa depths of over 500 fathoms are reached, and a small area of this basin falls below 800 fathoms. Opposite this deeper water, at the 100 fathom line, the islands of the Balkan coast disappear. The absence of good harbours on the Italian side contrasts with the excellent inlets of the Dalmatian coast. Here the rocks are mainly cretaceous and have characteristic features of dry barren soil and poor vegetation despite the fairly heavy rainfall. Some of the islands, however, are luxuriant with dark vegetation. The *bora* (north-east wind), and the prevalence of sudden squalls, are dangers to navigation in winter. Tidal movement is slight. (*See* also MEDITERRANEAN SEA.)

For the "Marriage of the Adriatic," or more properly "of the sea," a ceremony formerly performed by the doge of Venice, *see* the article BUCENTAUR. (X.)

**Political Question.**—Before the World War the Adriatic littoral belonged to four States, Italy, Austria-Hungary, Montenegro and Albania, and in practice to the two first. In negotiating the "secret" Treaty of London of April 26, 1915, the Italian Government aimed at securing, in return for Italy's entrance into the war on the side of the Allies, the conversion of the Adriatic into an Italian lake—*il nostro mare*.

Article 4 of that treaty provided that "all Istria up to the Quarnero and comprising Volosca, just beyond Abbazia and the Istrian islands of Cherso, Lussin . . . and the adjoining islets" with Castua and Mattuglie, the station for Abbazia, should become Italian Article 5 declared that Italy "shall equally receive the province of Dalmatia . . . comprising Lisarica and Tribanj in the north" to a line as far south as Cape Planca (Ploče), between Sebenico and Traù (Trogir), on the mainland, with "all the islands . . . from Premuda, Selve (Silba) and Pago in the north to Meleda in the south, comprising Lissa, Lesina, Curzola, Lagosta (Lastovo) and Pelagosa, with the solitary exception of Great Zirona (Veli Drvenik) and Small Zirona (Mali Drvenik), Bua (Ciovo), Solta and Brazza." The whole coast from Cape Planca to the "southern root" of the peninsula of Sabbioncello and from a point 10km. to the south of Ragusa Vecchia (Cavtat) to the river Viosa (north of Valona), except Montenegro, and all the non-Italian islands were to be neutralized. The rest of the Dalmatian coast, besides Fiume and the islands of Veglia and Arbe in the north, were to go to Croatia, Serbia and Montenegro, besides the Albanian roadstead of San Giovanni di Medua (the landing-place for Scutari); but Durazzo was to be Albanian.

Article 6 further conferred upon Italy "the entire sovereignity over Valona, the island of Saseno and a territory sufficiently extended to assure the defence of those points" (from the Viosa . . . approximately to the northern frontier of the district of Chimara). Article 7 neutralized the coast south of the above as far as Cape Stylos opposite Corfu. This treaty violated every principle of nationality; it assigned to Italy provinces overwhelmingly Slav (for the Italian population of Dalmatia was only 3·5%), it dismembered Albania and would have created a new Irredentism far more powerful than that which Italy had fought to cure. The entrance of the United States into the war made the treaty a dead letter, although Baron Sonnino, then Italian Minister of Foreign Affairs, still clung to it, for President Wilson refused

to be bound by it, and even some Italians, notably Bissolati and Prof. Salvemini disapproved of it.

Thus began the wearisome "Adriatic question," which at times threatened war between Italy and the Yugoslavs, and attempts were made by British publicists, notably Messrs. Steed and Seton-Watson, to bring about an agreement, the "Pact of Rome," between the two races. The departure of Sig Orlando, then the Italian premier, and Baron Sonnino from the Paris Conference was due to this question, which was not regulated till the Treaty of Rapallo between the Italians and the Yugoslavs on Nov. 12, 1920, largely the work of Signor Giolitti and Count Sforza, who had meanwhile become Premier and Minister of Foreign Affairs. In Dalmatia, Italy obtained only Zara—the one overwhelmingly Italian town—with an enclave which included the Albanian settlement of Borgo Erizzo—and the island of Lagosta. Italy kept the whole of Istria (despite its large Slav minority) with the islands of Cherso and Lussin and that of Pelagosa. "All the other islands which belonged to the former Austro-Hungarian Monarchy" were "recognized as forming part of the Kingdom of the Serbs, Croats and Slovenes."

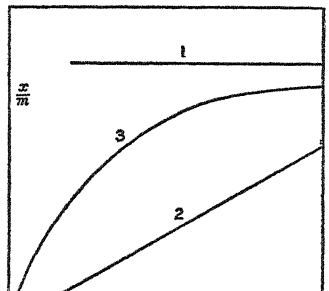
By article 4, both States recognized the full liberty and independence of the State of Fiume (*q.v.*), consisting of the *corpus separatum* (the city) and a corridor south of Castua (which became Yugoslav) connecting it with Volosca and Abbazia. Sig Giolitti evacuated Albania, where Italy retains only the island of Saseno. Mussolini observed the Rapallo Treaty and subsequently settled the question of Fiume, which is now Italian.

The Adriatic is described at Belgrade, no less than in Rome, as "our sea," but the keys of the mouth of the Adriatic, Brindisi and Saseno, are in Italian hands.

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**ADSCRIPT.** A *villein* was called an "adscript of the soil" (*adscriptus glebae*) since he could be sold or transferred with it, as in feudal days, and as in Russia until 1861. *See* VILLEINAGE.

**ADSORPTION.** If a gas or solution is brought into contact with a very finely divided or porous material (*e.g.*, charcoal, kaolin) the pressure of the gas or the concentration of the solution generally decreases, the gas or solute being concentrated on the surface of the solid. This phenomenon is known as adsorption, and the finely divided or porous solid is called the adsorbent The gas or solid can be easily removed from the surface of the solid by exhaustion, heating or washing. The efficiency of an adsorbent depends largely on its specific surface (*i.e.*, area of surface per unit mass), but as we shall see later it also depends on other factors.




CURVES OF THREE POSSIBLE TYPES OF RELATION BETWEEN THE PROPORTION OF GAS ADSORBED ON THE SURFACE AND THE PRESSURE OF THE GAS

This phenomenon of *ad*sorption is to be distinguished from *ab*sorption by the fact that the adsorbed gas or solute is concentrated on the surface of the adsorbent, while in absorption the matter taken up penetrates throughout the mass of the absorbing agent. (*See* ELECTRIC LAMPS AND VALVES, MANUFACTURE OF.)

**The Adsorption of Gases.**—Wood charcoal is very porous; so that it possesses a large specific surface, and is very efficient as an adsorbent. On exposure to the air it adsorbs the atmospheric gases. In order to demonstrate its adsorbing properties it should first be heated to redness in order to remove the adsorbed gases from its surface. If then it is brought into a vessel containing a gas, an immediate diminution of pressure would be indicated by an attached manometer, reaching eventually a constant value. This final equilibrium pressure depends on the temperature, the nature of the gas and adsorbent, and also on the specific surface of the latter. Adsorption can also be shown by filling a glass tube with ammonia with the open end of the tube dipping into a trough of mercury. A piece of charcoal (after being heated to redness and allowed to cool) is introduced on to the surface of the mercury in the tube The mercury rises rapidly in the tube, indicating a rapid diminution in the volume of the gas. The ammonia can be recovered from the charcoal by heat or by exhaustion. Hydrogen burns with a pale blue flame which is non-luminous; if the hydrogen is bubbled through benzene it burns with a smoky luminous flame due to the presence of benzene vapour. If the mixture of hydrogen and benzene vapour is passed over charcoal the benzene is adsorbed, as shown by the non-luminous character of the flame of the gas which passes through.

When an adsorbent remains for some time in contact with a gas, an adsorption equilibrium is established, the amount of gas adsorbed per unit mass of the adsorbent increasing with decreasing temperature and with increasing pressure. By plotting the pressures $p$ as abscissae, and the amount of gas adsorbed per unit mass of the adsorbent as ordinates, curves similar to those shown in figure (Curve 3) are obtained. Such a curve, which represents the amount adsorbed at constant temperature, is termed an "adsorption isothermal." It is seen from the curves that the amount of gas adsorbed is not proportional to the gas pressure, but that it increases much more rapidly at low pressures than at high pressures. The adsorption isothermal can be represented by the equation:

$$x/m = ap^{1/n}$$

where $x$ is the amount of gas adsorbed by $m$ grams of the adsorbent at gas pressure $p$; $a$ and $n$ are arbitrary constants. The value of $a$ depends on the units of measurement, and $n$ is characteristic of the adsorbent and of the gas. Thus, for the adsorption of $CO_2$ $NH_3$ or $SO_2$ on charcoal, the values of $1/n$ are 0·394, 0·437 and 0·324, respectively, whereas for the same three gases on glass, the values are 0·66, 0·53, 0·28. These constants also vary with the temperature, $1/n$ approaching unity at high temperatures. The temperature at which the unity value is reached depends on the critical temperature of the gas. For hydrogen, which has a very low critical temperature, the value of $1/n$ is unity at ordinary temperatures, but it is less than unity at the temperature of liquid air. In general the value of $1/n$ becomes 1 at temperatures considerably above the critical temperature of the gas.

The logarithmic equation of the isotherm is:

$$\log x/m = \log a + 1/n \log p,$$

which is the equation of a straight line. On plotting experimental values, however, it is found that it only holds at low pressures. As the pressure increases the logarithmic curve ceases to be a straight line, and bends towards the pressure axis. The pressure at which this deflection occurs varies from gas to gas; it is lower the more readily the gas is condensed. Below the critical temperature the equation does not hold for even low pressures. The adsorbability of gases runs more or less parallel with their condensability. The above equations, which are due to Freundlich, imply that an indefinite increase in pressure produces an indefinitely large adsorption. Recent work by Langmuir and others indicates that on increasing the pressure surface saturation is reached. Arrhenius introduced this ($s$) into his equation for adsorption, viz., $k \cdot dx/dp = (s-x)/x$.

The rate of adsorption is high, equilibrium being reached in a few minutes. The kinetic equation is $dp/dt = k(p\infty - p)$, $dp/dt$ being the rate of diminution of pressure; $p\infty$ and $p$ being the pressures at equilibrium and at time $t$ respectively. Since adsorption is decreased by a rise in temperature, it follows that it is accompanied by evolution of heat. This can be readily shown by means of a thermometer immersed in the adsorbent when adsorption takes place. The heat of adsorption can be calculated from the temperature-coefficient of adsorption. If the adsorbent is in contact with several gases at the same time, the adsorption of each is diminished, and at equilibrium the amounts of the several gases adsorbed are in proportion to their respective adsorbabilities. Nothing is definitely known about the influence of the nature of

the adsorbent. Wood or animal charcoal is by far the most efficient. Silica gel is also a very powerful adsorbent. In the adsorption of *gases* on the surface of solids the adsorbed gas forms a layer one molecule thick on the adsorbent, but in the adsorption of *vapours* the layer may be several molecules thick.

**Adsorption in Solution.**—Small drops of a pure liquid, when free from external influences assume a spherical shape. This can be seen with drops of water on a waxy surface—if the drops are large then the effect of gravity is appreciable and the drops become flattened. A liquid suspended in another liquid of the same density and in which it is insoluble also assumes a spherical shape. The second law of thermodynamics states that free energy always tends to become a minimum, and in the case of liquids the free surface energy therefore tends towards a minimum. The free surface energy of a liquid is the product of its surface tension and the area of its surface, so that if there is a diminution in the surface tension or in the superficial area there is a diminution in the free surface energy. A pure liquid cannot change its surface tension, but its surface area is reduced to a minimum if it assumes a spherical shape, for it is characteristic of a sphere that for a given volume it has the minimum surface. If we consider a liquid containing a substance in solution, and having a lower surface tension than the pure liquid, *e g.*, a solution of one of the fatty acids in water, we find that the lowering of the surface tension results in a lowering of the free surface energy of the liquid; the effect is all the greater the more concentrated the solution. The free surface energy would decrease still further if there were an unequal distribution of the solute in the solution, *i.e.*, if the concentration of the surface layer of the solution were greater than the concentration of the bulk of the solution. This is found to be the case in all solutions where the solute lowers the surface tension of the solvent, and we may state generally that those solutes which decrease the surface tension of the solvent are concentrated at the surface, and, conversely, those solutes which raise the surface tension of the solvent have a lower concentration in the surface layers than in the bulk of the solution. This generalization is known as Gibbs's adsorption theorem. The increase in concentration of the solute at the surface is a case of adsorption of the solute at this surface. Solutions of low surface tension are apt to foam or froth. Conditions favourable to frothing are low surface tension, low volatility and not too high mobility of the liquid. Pure liquids do not froth. A solution of soap in water froths very readily; if this froth is collected it is found to contain a much greater concentration of soap than the bulk of the liquid, *i.e.*, the soap has been adsorbed on the air-liquid surface.

**Adsorption of Solutes by Solids.**—The adsorption of solvents by solids is explained in exactly the same way as that of solutes at the gas-liquid interface. It is the application of Gibbs's adsorption theorem to the distribution of the solute. Those solutes which lower the surface tension at the liquid-solid interface will be concentrated or adsorbed at that surface and vice versa. When the surface area of the solid is very large (porous or very finely divided solids), the free surface energy assumes very high values, and may be considerably reduced as a result of adsorption. In the case of the gas liquid interface, the surface tension, and consequently the free surface energy, can be readily determined, and thus the results of adsorption interpreted quantitatively. It does not follow that a decrease in the surface tension at the gas-liquid interface involves a decrease in the surface tension at the liquid-solid interface. The measurement of the surface tension in the latter case is extremely difficult, and the results are not trustworthy. If charcoal is shaken with a solution of methylene blue in water, a decrease in the concentration of the solution is indicated by a decrease in the intensity of its colour. A similar result is obtained by shaking charcoal with a solution of the fatty acids, amines, phenols, etc., in water; the solutes are adsorbed by the charcoal, since they lower the surface tension and therefore the free surface energy at the solution-charcoal interface.

In the case of solutes which raise the surface tension of the solvent, the converse holds, *i.e.*, the concentration of the surface layers will be less than that of the bulk of the solution, and the concentration of the solvent is relatively greater at the solid–liquid surface. We thus have two cases of adsorption; the first, resulting in a diminution in the concentration of the solution, is generally known as positive adsorption, and the second, resulting in an increase in the concentration of the solution, is known as negative adsorption.

It has been suggested that liquids in contact with charcoal are actually compressed on the surface of the solid, and this pressure has been estimated at 10,000 to 60,000 atmospheres. Positive adsorption is utilized largely in industry. Bancroft has determined the efficiencies of the more important decolorizing agents

| *Material* | *Efficiency* | *Material* | *Efficiency* |
|---|---|---|---|
| Alumina | 100 | Bone charcoal | 17 |
| Fuller's earth | 50 | Ferric oxide | 3 |
| Bauxite | 40 | Kieselguhr | 3 |

The amount of adsorption generally decreases with increasing temperature, but the rate of adsorption increases with increasing temperature. In adsorption efficiency, specific surface plays a very important part—the higher the specific surface the more efficient the adsorbent. Freundlich's isotherm for adsorption from solution is:

$$x/m = Kc^{1/n};$$

$x/m$ is the amount of solute adsorbed per unit mass of adsorbent; $c$ is the concentration of the solution at equilibrium; $K$ and $n$ are constants, the values of which vary considerably (*e.g.*, $n$ varies between 1 and 5), and depend on the temperature, nature and specific surface of the adsorbent, and also on the solvent.

The adsorption isothermal defines the relationship between concentration in the solution and the quantity adsorbed, as with gases; at small concentrations relatively more is adsorbed than at higher concentrations. This relationship only holds for dilute solutions: at high concentrations a saturation value is reached—in fact, at very high concentrations the amount adsorbed seems to decrease, due to more of the solvent being adsorbed. The adsorption of a salt is an additive property of the cation and the anion; thus, the adsorbability of a series of potassium salts is in the same order as that of sodium salts. The order of adsorbability of cations is as follows: Organic dyes (basic), $H^+$, $Ag^+$, $Hg^+$, $Cu^{++}$, $Al^{+++}$, $Zn^{++}$, $Mg^{++}$, $Ca^{++}$, $NH^+_4$, $K^+$, $Na^+$; and for the anions: Organic dyes (acidic), $OH^-$, $CN^-$, $S^{--}$, $I^-$, $NO^-_3$, $Br^-$, $Cl^-$, $SO^{--}_4$. Apart from the organic dyes, hydrogen and hydroxyl ions are the most readily adsorbed. In the case of the metals, the valency and the position of the element in the electrolytic potential series seem to be of importance. This preferential adsorption of $H^+$ and $OH$ gives the adsorbent a positive or negative charge, and explains the origin of the electric charge on colloidal particles. The coagulation of colloidal solutions by electrolytes is also explained by the preferential adsorption on the surface of the colloidal particles of one ion which neutralizes its charge (*see* Colloids).

If we consider the adsorption of methylene blue by kaolin, we find that the adsorbent is very efficient, much more efficient than in the adsorption of the fatty acids, etc. The solute in the case of methylene blue is highly ionized, and it comes into contact with a solid (calcium silicate) whose anion is extremely insoluble, but whose cation readily goes into solution. The calcium ions of the solid therefore change places with the methylene blue cation in solution. This kind of adsorption is known as exchange adsorption and is polar in character.

**Theories of Adsorption.**—Three theories of adsorption have been advanced: (1) Chemical theory; (2) Solution theory; (3) Surface theory.

**Chemical Theory.**—If one regards adsorption equilibria as chemical equilibria, then the adsorption isotherm must be a special case of the law of mass action (*see* Chemical Action). If one considers the adsorbent and the compound of the adsorbent and adsorbed substance as solid phases of constant composition one must also assume a phase of variable composition (a solid solution) in order to apply the adsorption isotherm. Then the adsorption equilibrium can be regarded as a chemical equilibrium. The opponents of this theory claim that chemical equilibrium is very

specific, the equilibrium and velocity coefficients vary considerably with the nature of the reacting molecules (in the adsorption isotherm this is $1/n$). Adsorption equilibrium, on the other hand, is but slightly specific; the constant $K$ (the equilibrium constant in the law of mass action) does not vary much under very different conditions; the same applies to $1/n$. The chemical theory makes it difficult to understand the relation between the adsorbability of a gas and its condensability, or the influence of a solute on the surface tension of a solvent and the readiness with which it is adsorbed. Again, the chemically inactive gases helium and argon are adsorbed.

**Solution Theory.**—Adsorption as a solution phenomenon has but few adherents. In adsorption, equilibrium is rapidly established, but diffusion in a solid is extremely slow. Again to bring the phenomenon of adsorption into line with Henry's law, one must assume the dissociation of the gas, which is highly improbable in most cases Some suggest that the gas is liquefied on the surface of the solid; this explains the relationship between adsorption and condensability of gases, but does not assist in the case of adsorption from solution.

**Surface Theory.**—Many regard adsorption merely as a concentration on the surface of the adsorbent in accordance with the second law of thermodynamics. Assuming the validity of the gas laws and van't Hoff's law for dilute solutions, the following equation can be deduced thermodynamically:

$$u = -c/RT\, d\sigma/dc$$

where $u$=excess of gas or solute in the surface layer; $c$=concentration of solution (pressure of gas); $R$=gas constant; and $T$=absolute temperature.

It is difficult to test this equation in the case of solid surfaces because of the difficulty of determining the value of the surface tension $\sigma$. In the case of gas–liquid and liquid–liquid surfaces, the experimental results agree qualitatively, but quantitative results are difficult to obtain on account of the necessity of using very large surfaces

The laws of chemical combination, solution and adsorption are represented by the curves in figure.

Curve 1: $x=K$ (law of constant composition). Action is due to the attractive forces between the atoms or molecules.

Curve 2: $x/p=K$ (Henry's law of solubility).

Curve 3: $x/p=K^{1/n}$. $K$ is given an exponent between 0 and 1, the values found in the case of chemical combination and solubility respectively. This phenomenon is due to molecular attraction and also to the kinetic motion of the molecules.

Modern research tends to bring together the extreme views (chemical and physical) of adsorption. At one time the phenomenon was regarded as purely physical and non-specific; adsorption is now shown to depend on a variety of factors, many of which are extremely specific and closely related to chemical phenomena. I. Langmuir and N. K. Adam studied the behaviour of oils spread in unimolecular layers on water, and found that the forces operating were not readily distinguishable from chemical forces or affinity.

**Applications of Adsorption.**—Cocoa-nut charcoal is generally employed at very low temperatures (temperature of liquid air). Adsorption facilitates the separation of the difficultly adsorbed gases hydrogen and helium from the more easily adsorbed, such as nitrogen and oxygen. The effectiveness of gas masks depends on the efficiency of the charcoal which they contain for adsorbing such poisonous gases as chlorine, phosgene, etc. A very active and porous grade of charcoal is also used in an important process for the adsorption of gasolene from natural gas.

Adsorption is of very great importance in chemical reactions, for many of them are accelerated on various solid surfaces, and this has found extensive application in industry. Mention need only be made of the contact process for the manufacture of sulphuric acid (*q.v.*), the synthesis of ammonia (*q.v.*), hydrogenation (*q.v.*) of oils, etc. Catalytic poisoning is also due to adsorption. (*See* CATALYSIS.) In dyeing, adsorption plays a very prominent part in the fixing of the dye on the material, although the formation of compounds may also play a part in some cases. In the photographic plate the silver bromide is in the colloidal form and adsorbs the sensitiser. In brewing, the gas content and taste of the beer depend largely on adsorption of the colloidal particles The growth of crystals from solution or from a molten mass is frequently influenced by the presence of other substances in solution: this rate of growth of the crystals in different directions determines their shape.

Adsorption plays a very important part in the agglutination of bacteria, and in the neutralization of a toxin by an anti-toxin In the field of public health we find adsorption of importance Aluminium hydroxide and ferric hydroxide, which are present in the soil, are very pronounced adsorbents, and filtration through soil is therefore a very efficient means of freeing sewage and other waste water from colloidal organic particles This is also of importance to agriculture as the means whereby the soil is able to retain solvents from solutions which percolate through it

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**ADULIS** (mod. *Zula*) —An ancient city of Eritrea. According to Pliny, it was founded by slaves who had fled from their Egyptian masters. Excavations have led to the discovery of a considerable amount of prehistoric pottery, and of various buildings, including an altar of the Sun and two Christian churches The principal periods of its prosperity were the Ptolemaic, Graeco-Roman and Christian The city, as far as can be ascertained, had neither fortifications nor walls.

*See* R. Paribeni in *Monumenti dei Lincei,* xviii. (1907) 437 *sqq.*

**ADULLAM,** a Canaanite city (Gen. xxxviii. 2), fortified by Rehoboam (2 Chron. xi. 7), and still a place of importance at the time of the Maccabees (2 Mac. xii. 38). Its chief interest lies in its connection with David who took refuge in its stronghold ("Cave" is a scribal error) on two occasions (1 Sam. xxii. 1; 2 Sam. v. 17). A site on the eastern edge of the Shephelah in the neighbourhood of Socoh (Shuweikah) seems to be indicated. Conjectural identifications are (1) Khareitun, south-east of Bethlehem, which has a large cave but nothing else to commend it. (2) Deir ed-Dibban, some 6m. east of Shuweikah, where there are caves and (3) Aid el-Ma'ˁ, south of Shuweikah and at no great distance from it The last identification is the one most favoured. The name, which appears to represent an Arabic reconstruction of Adullam, the position and the physical characteristics of the site support it. In modern political history the term "Cave of Adullam" was applied by John Bright to certain Liberals who seceded from their party to oppose the Reform Bill of 1866. But the expression had been used earlier by President Lincoln (1864). From the same usage is derived the shorter political term "Cave" for any body of men who secede from their party on some special subject.

*See* Clermont Gannean, *Pal. Expl. Fund Quart. Statement,* 177 (1875); G. A. Smith, *Hist. Geography of the Holy Land,* 229f (1910).

**ADULT EDUCATION,** a phrase originally meaning education of adults who have not been properly educated as children. As the educational system improved, the need for such education diminished, but as democratic government developed, it brought with it the need, felt by everyone, for education in citizenship. Adult education in this sense has been described as "an inseparable aspect of citizenship" and the new movement, which dates from the beginning of this century, has extended to democratic countries all over the world, including such countries as Germany and the United States. Because these countries had early possessed a comprehensive system of elementary and secondary education, they have not felt the need for adult education in its original sense. (*See* Adult Education in the United States, page 185.) It is often also distinguished as non-vocational adult education from the vocational education now given to adults in technical and commercial colleges in many parts of the country.

The new movement has taken many forms and is carried on

by many different organizations which held ideals that were at the same time high and practical. Thus in England the Workers' Educational Association, founded by Albert Mansbridge in 1903, originally aimed at bringing together working-class organizations to provide for an education, designed not to take men out of their class or trade, but to equip them, whatever their occupation in life should be, for the work of citizenship. It was to be a highway and not a ladder. The education it desired to bring into being was to be broad, impartial and scholarly, was to aim at a higher university standard and was to enlist the aid of the universities and of public authorities.

The universities were asked to help in maintaining the standard of education, but the choice of subjects and of tutors was to be with the students. It was recognized that adult students bring an experience of life and an understanding of practical problems which are as important a contribution as the more theoretical knowledge of the teachers, and that adult education, therefore, requires a technique and organization in which both students and university trained teachers have their parts to play

**Tutorial Classes.**—In 1907 the University of Oxford organized the first tutorial class, the characteristic educational instrument of the new movement. These classes were small, between 20 and 30 persons, meeting once a week in the winter over a period of three years. Each class period consisted of an hour's lecture and an hour's discussion, the students undertaking from the start to attend for the full period of three years and to do written work. The classes were under the control of a joint committee consisting of equal numbers of representatives of the university and of working-class organizations The quality of work done in these classes was often of a good university standard. All the other universities of England and Wales followed the example of the University of Oxford, and in 1925 there were over 500 tutorial classes with 12,000 students, while the number of affiliated bodies was 2,500 and of independent members 23,000. The Board of Education has supported this work from the beginning and through its inspectors and the reports of its advisory adult education committee done much to further the standard of the teaching given Most local education authorities now give some support to adult education by grants either to tutorial classes or to the more elementary one-year classes and terminal courses which have greatly increased in numbers

The total amount of education of this kind given in democratic countries is very considerable and is rapidly increasing The movement is still young and its future organization is still uncertain. Its great strength in the past was that it has been run by voluntary associations and has in a real sense been a university controlled in the main by its students. It suffers, however, from the weakness of administration and the fluctuating enthusiasm characteristic of all voluntary organizations. Its success in the future will depend on how far it can be connected more closely with public educational institutions on the one hand and organized labour on the other, without losing its voluntary character. The British Institute of Adult Education attempts to survey and coordinate by the publication of its journal and other literature, and by the holding of conferences, the work of the various organizations in the country which are concerned with adult education. The World Association of Adult Education is working to spread knowledge of adult education in all parts of the world.

See *Final Report* of the Adult Education Committee (Cmd. 321, 1919) and *Journal of the British Institute.* (A. D. L.)

## UNITED STATES

In the United States the term adult education is used to denote an educational movement for men and women, young and old, who no longer are in contact with formalized education and whose primary interest lies in a vocation but who possess a secondary interest in their own educational improvement as a sustained and continuing process. It is sometimes called "continuing education." It [illegible] from any sort of schooling as a commencement [illegible] opportunity extending throughout life.

While the movement was not recognized in the United States under the name "adult education" until 1924, its roots were already deeply imbedded in American life The New England town meeting of the 17th century formed the initial adult education venture of record in the English colonies of North America It was a logical next step to the formation of the first lyceum in Massachusetts in 1826, a voluntary association of farmers and mechanics "for the purpose of self-culture, community instruction and mutual discussion of common public interests." The town lyceums made rapid growth and in 1839 more than 3,000 were in existence. They assumed an educational leadership with the years, Emerson, Thoreau, Lowell and Holmes among others lending them prestige. It was the example of the lyceum which led Bishop John H. Vincent and his colleagues in 1874 to expand a Sunday school association into a general adult education venture. The Chautauqua Institution (*see* LYCEUMS and CHAUTAUQUAS) resulted and in its train numerous imitators, later to be served by the commercial Chautauqua and lyceum circuits. The last quarter of the 19th century saw the beginnings of the university extension movement and with the 20th century impetus to popular education was given through Andrew Carnegie's large benefactions to public libraries. Meanwhile the tax-supported school system, as the compulsory school age was pushed upward, had instituted a series of vocational extensions, soon accompanied by such non-vocational enterprises for adults as the voluntary evening high school.

The increase in public estimation of these agencies gave rise to many other forms of educational activity for adults. Most of them were based on the American tradition of education at cost, less than cost or no cost to the student. In addition there were devised, to meet the recognized educational needs of large numbers of people, certain commercial organizations known as private correspondence schools (*see* CORRESPONDENCE SCHOOLS) operated for profit under modern salesmanship methods. Almost wholly vocational and technical in nature, these courses attracted such numbers that in 1927 the current enrolment was estimated at more than 2,000,000 persons who were annually expending $70,000,000 for the instruction offered

An inquiry into adult education needs and possibilities in England and Scotland, made as a part of the British ministry of reconstruction report of 1919, had resulted in the phenomenal growth of adult classes in those countries. Increasing recognition of the British movement and observance of a considerable American interest in various forms of continuing education led to an inquiry into American conditions, instituted in 1924 by the Carnegie Corporation of New York. Five volumes constituting reports on as many broad phases of the general subject were published, a series of regional and national conferences of teachers and leaders of adults was held and, in March, 1926, there was formed the American Association for Adult Education with headquarters in New York. It serves as a national clearing house for information, sponsors and initiates researches and studies, and supervises and conducts experiments and demonstrations in co-operation with local and national agencies.

**Urban and Rural Community Organization for Adult Education.**—The initial attempt in the United States to organize an entire community's educational facilities with special reference to the adult and his needs was made in Cleveland in 1924. The Cleveland Conference for Educational Co-operation resulted and later a complementary body, the Adult Education Association of Cleveland. In 1925, Buffalo, organized similarly, conducted a self-survey under the auspices of a co-operative group known as the Buffalo Educational council. The survey has since been published and the recommendations of the council are rapidly becoming effective. The Cleveland and Buffalo examples have brought together like groups in Chicago, Detroit, St. Louis and Brooklyn. Plans for organization have been made in eight other cities. In addition, Dallas, Texas, in its Civic Federation and Institute for social education, founded in 1920, furnishes perhaps the best example in the country of a private educational venture for adults. Representatives of the various community enterprises have formed a national community conference which has affiliated

itself with the National Community Foundation. The latter organization is conducting, on an experimental basis, community organization activities and educational programmes in 60 small cities and towns of the Middle Atlantic States. It co-operates with its related organization, the Swarthmore Chautauqua. Michigan state college is experimenting with continuing education for rural areas in two Michigan counties selected for the purpose. A preliminary survey has been made and responsibility has been assumed by local groups. The California State board of education has likewise initiated a rural county demonstration. A privately supported small town circuit in western New York has been formed, initiating programmes in 16 centres.

**Tax-Supported Adult Education.**—Approximately 100,000 men and women are enrolled in public evening schools (*see* CONTINUATION SCHOOLS) annually. They are almost exclusively in urban centres of 25,000 population or more. The work offered is either the same as the day school, designed to meet the needs of those who have had to leave school for economic reasons, or technical courses for vocational preparation, or classes for immigrants desiring to learn English. The last group has diminished rapidly since the revision of the immigration laws, although evidence is at hand that the need for such instruction still is large. The continuation school (*see* CONTINUATION SCHOOLS) is newly established and is found in only half the States of the Union and there only in the larger urban communities. It requires from four to 18 hours of student school time each week. The co-operative school, originating at the University of Cincinnati is still in an experimental stage. It provides for equal division of time between class-room and work in a factory. The usual practice is to alternate weeks. Antioch college, O., is wholly given over to the industrial co-operative idea.

**Private Technical, Commercial and Correspondence Schools.**—Thousands of business schools (*see* COMMERCIAL EDUCATION), trade schools (*see* TECHNICAL EDUCATION; INDUSTRIAL SCHOOL), and technical institutes, conducted for profit and in a relatively small number of cases, philanthropically endowed, operate in cities of all sizes throughout the country. They vary widely in efficiency and in repute. The schools of this type which utilize the correspondence method of instruction have reached large proportions in the United States. Of the 1,500,000 new students enrolled each year, 95% wish to obtain vocational training and pay from $10 to $280 for each course, the average payment being about $40. Extensive advertising methods are employed, from 30% to 80% of all tuition fees received being devoted to course salesmanship. Efforts are being made by the Federal trade commission, by the Better Business bureau of the National advertising clubs and by the National Home Study council, an association of correspondence schools, to improve business ethics and to create instructional standards.

**Schools Operated by Religious Organizations.**—Each of the large associations originally organized for religious and social purposes maintains an educational activity as an auxiliary phase. The Young Men's Christian Association (*q.v.*) enrolls about 90,000 young men, mostly in evening classes which are chiefly of a vocational nature but which recently have shown a trend toward the non-vocational. The Young Womens Christian Association (*q.v.*) has an even more widespread educational programme, though of a much more informal nature than that of the Young Men's Christian Association. Its emphasis is definitely on the side of cultural studies. The Knights of Columbus (*q.v.*) and Young Men's and Young Women's Hebrew associations repeat the patterns of the other associations on a smaller scale.

**Corporation Schools.**—Education for workers is of two general types in the United States: that provided by the workers themselves and that provided by the employers. In the latter group fall some interesting experiments in education for the job-vocational education designed for immediate practical use in the industry which offers it. The larger corporations such as the Standard Oil Company, The Westinghouse Company, the telephone and allied interests, and to a lesser degree the automobile manufacturers, have educational departments which take employés from apprentice courses to the highest technical branches.

**Workers' Education.**—Although sporadic efforts had been made during the preceding quarter century, it was not until after the World War that an organized educational movement of wage-earners assumed sizable proportions in the United States. In 1921 a group of trade unionists and teachers in New York formed the Workers' Education bureau of America as a national organization to serve as a clearing house for information and to establish study classes. The bureau has since become the agency through which the American Federation of Labor carries on its entire adult education programme for its membership. It has not only increased the number of workers' classes, but has published text-books, syllabi and study outlines. Of the dozen or so labour colleges scattered through the country, the residential Brookwood Labor college at Katonah, N.Y., is the best known. It has a two-year course and also conducts special summer institutes. The International Ladies' Garment Workers' union has the most highly developed educational programme among national unions, although those of the United Mine Workers in Illinois and Pennsylvania are worthy of note. In California, the State Federation of Labor and the University of California Extension Division have embarked upon a joint programme for workers.

**Special Summer Schools.**—At Bryn Mawr college, a summer session for women workers in industry is held annually for 100 women workers, equally divided between unionized and non-unionized workers. The Bryn Mawr plan has been successfully adopted at the University of Wisconsin, Barnard college of Columbia university, New York, and at Sweetbriar college, Virginia. The National League of Girls' clubs holds an annual summer session on Long Island for mill girls, stenographers and other industrial workers, initially trained in the league's winter classes in New England and Middle Atlantic States. These summer schools are not to be confused with those conducted in great numbers by the universities and colleges throughout the country (*see* SUMMER SCHOOLS) which, while open to adults generally, are chiefly attended by teachers and college students. The California State board of education in 1927 initiated a series of special summer schools of adult education to be held annually. The first session was held at Mills college, Oakland, with an attendance of 250. The Chautauqua Institution of New York conducts a two months' summer session annually attended by about 12,000 people. This course is comparable with a university summer session. In addition winter reading courses are attended by 10,000 persons.

**University Extension and Adult Education.**—The total enrolment of university extension students in the United States, exclusive of agricultural extension (*see* UNIVERSITY EXTENSION and AGRICULTURAL EDUCATION) may conservatively be estimated at 250,000. The university extension movement (*see* UNIVERSITY EXTENSION), through lectures, visual education media, correspondence courses, exhibits, discussion groups, reading circles, etc., easily reaches five times that number. If the 5,000,000 members of farm families reached by the State agricultural colleges in co-operation with the Federal department of agriculture be added to the general extension total, it will be seen that university and college extension is the most important factor numerically in adult education in the United States.

**Libraries and Museums.**—Through the activities of the board on the library and adult education of the American Library Association, the 4,000 communities in the United States which have their own public library facilities, together with a number of State and regional organizations, have been acquainted with a new conception of the library as a dynamic agency of education. Many of the larger libraries have instituted readers' advisory services providing individual attention for every serious reader, including the preparation of special reading courses. This association has published a "Reading With a Purpose Series" consisting of more than 40 pamphlets, each of which is a short introduction to a given subject together with a list of half a dozen recommended books in the field. Hundreds of thousands of copies of these pamphlets have been sold and distributed. (*See* LIBRARIES and SCHOOL LIBRARIES.) By means of lectures, gallery talks, guidance for visitors, publications for the layman, loan collections, travelling exhibits, consultation hours for students and manufacturers, and

formal classes, a great educational work has also been done by the museums.

**Chautauquas and Lyceums.**—The modern chautauqua and lyceum serve towns of less than 2,500 population almost exclusively. With the exception of one circuit, they are conducted for profit. The competition deriving from the radio, motion pictures and cheap transportation has resulted in large financial loss to the chautauqua and lyceum operators of late years and it is questionable whether this form of combination lecture and entertainment bureau will persist in the U.S. The commercial chautauquas are not to be confused with the Chautauqua Institution of New York.

**Women's Clubs, Parent Groups and Forums.**—Three million women in the United States belong to women's clubs, in towns and cities of all sizes. Study materials are prepared by national and state offices which form the bases of educational programs throughout the year. With the public school as the basic unit, hundreds of thousands of parents, chiefly mothers, are united in parent-teacher associations, child study (*see* CHILD STUDY ASSOCIATIONS), child welfare groups, etc. They are served by several national organizations. Each group is engaged upon an educational program. Certain of the large state universities, notably Iowa, Minnesota and California, have recently assumed responsibilities in relation to the parental education program within their respective areas. Varying greatly in accordance with the communities which they serve, open forums flourish in many parts of the country. They are purely individualistic and autonomous; half of them are conducted by Protestant or Jewish churches.

**Individual Enterprises.**—Certain individual enterprises reflect the best which the nation has to offer in adult educational thought. Among these should be cited the People's Institute of New York, founded in 1897 as a forum for public discussion. Courses of instruction of a high standard and individual lectures are offered. In its school, the institute conducts experimental classes for adults in various parts of New York city. Similarly, the New School for Social Research of New York city may be considered an adult education enterprise. There are others of less note, including at least three Danish folk school experiments which have not yet demonstrated their adaptability to U.S. life.

(M. A. C.)

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**ADULTERATION,** the act of debasing a commercial commodity with the object of imitating or counterfeiting a pure or genuine commodity, or of substituting an inferior article for a superior one in order to gain an illegitimate profit. The term adulteration is usually applied to the debasement of foods, drugs or cosmetics; but adulteration may be said to be practised by profiteering contractors who substitute sand for cement in the concrete used for public buildings or by purveyors of woollen goods whose fabric is composed largely of cotton.

Adulteration has been practised by less responsible persons of almost every trade and profession, and its origins are lost in prehistoric times. So widespread and pernicious did this practice become that in ancient and mediaeval times laws were enacted to curb the most flagrant abuses. The common law dealing with fraud is in most cases sufficient to deal with the ordinary forms of adulteration, but all civilized nations found it necessary to enact special legislation to deal with adulteration of foods and drugs.

There are numerous references to adulteration in the classics. Elisha, the biblical prophet, was warned that the herbs of which his pottage was made were poisonous weeds by the cry, "There is death in the pot." Pliny the Elder complained of the "white earth" added to the bread baked in the days before the destruction of Pompeii.

Both Athens and Rome enacted laws to prevent the adulteration of wine with colours and flavouring agents. Because of the economic importance of spices in the middle ages, the temptation to market sophisticated products was great; and in 1316 the pepperers or spicers of London began to regulate the quality of their produce. During the reign of William the Conqueror, brewers were subject to severe fines for adulterating beer. During the reign of John (1203), the first proclamation regarding the adulteration of bread was made The first statute specifically prohibiting the adulteration of human food was enacted during the reign of Henry III. In France and Germany, food control statutes were passed in the 13th century. The artificial colouring of butter was prohibited by the *prevost* of Paris in the 14th century.

## MODERN LEGISLATION

Both Great Britain and the United States enacted laws from time to time widening the control exercised over foods and drugs. The initial laws dealt principally with adulteration and were designed to prevent specific abuses Adulteration of food received the earliest legislative attention, partly because the practice was widespread and affected the greatest number of people and partly because the honest purveyors of foodstuffs were placed at an economic disadvantage from which relief could not be obtained otherwise Increase in legislative control was brought about by technological advances in the food industry such as the development of commercial canning, production of processed foods and the gradual shift of the population from agrarian pursuits to industrial employment with the resultant growth of large cities and the attendant problems of food distribution. This change in character of food production and distribution proceeded most rapidly from about 1865 to 1920 although commercial canning actually began in Europe in 1810, and in 1940 frozen foods were just beginning to become popular in the United States.

**British Legislation.**—One of the earliest acts of the English parliament dealing with food adulteration was directed at the sophistication of tea. The acts of 1725 and 1730 prescribed penalties for adulteration of this commodity. Similar acts were passed dealing with coffee in 1718 and with cocoa in 1803. The addition of extraneous colouring matters to beer and porter was prohibited in 1816. These laws were penal in nature and served the double purpose of ensuring the integrity of the articles subject to them and of furnishing inland revenue. The enforcement was left in the hands of revenue officers.

Dr. Arthur H. Hassall was one of the first to utilize the microscope to detect adulteration. In 1850 he demonstrated that adulteration of coffee with chicory could be determined by this method, and he was commissioned by Thomas Wakley (1795–1862), owner of the *Lancet,* to extend his examination to other articles of food. Hassall's findings were published as reports of the Lancet Analytical Sanitary commission. Adulteration was found to be rampant, and scarcely any common foodstuff was found which was not adulterated. These disclosures and the pressure of public opinion resulted in the appointment of a parliamentary committee in 1855, and in 1860 the first act that dealt directly with the adulteration of food, known as the Adulteration of Food and Drink act, was passed. This act did not provide a clear-cut procedure for its enforcement nor did it provide for a responsible enforcing body. As a result this act, though praiseworthy in intent, was wholly ineffective. The Adulteration of Food and Drugs act (1872) provided for the purchase of samples by inspectors and the analysis of such samples by analysts. Penalties were prescribed: a fine of £50 for the sale of an injurious food and six months' imprisonment at hard labour for a second offense. This act defined an adulterated article as "any article of food or drink or any drug mixed with any other substances, with intent fraudulently to increase its weight or bulk, without declaration of such admixture to any purchaser thereof before delivering the same." In essence this definition is that followed in subsequent acts. Little attention was paid to this act outside of London and a few small towns, but cases which did arise under the act soon revealed weaknesses and defects which occasioned complaints Among the difficulties complained of were the differences in interpretation of the definition of adulteration by various courts

and by different analysts, and the severity of the penalties imposed for minor deviations from the law.

The Sale of Food and Drugs act, 1875, attempted to correct the defects of the earlier law. This act avoided the term "adulteration" and attempted to define with some precision prohibited practices. It provided for the compulsory appointment of analysts in the City of London, the vestries, county quarter sessions and town councils or boroughs having separate police establishments. Conflicting decisions in the courts, lack of uniform regulations with respect to sampling and analysis led to endless disputes and considerable injustice in its operation. Since dairy products constituted one of the principal classes of food subject to adulteration, the bulk of the early cases under this act dealt with these products Furthermore, during the decade following the passage of the act, a multitude of butter substitutes made their appearance, and the anguished cries of the dairy industry resulted in the passage of the Margarine act of 1887, which provided for distinctive labelling of butter substitutes.

The need for precise legal standards or definitions for articles of food was apparent in the conflicting decisions of the courts and varied interpretations placed by different analysts on their findings. In 1894 a select committee was appointed to consider the defects of the act of 1875 and recommend remedial measures Its recommendations resulted in the Sale of Foods and Drugs act of 1899, which, unfortunately, was not comprehensive but merely amended and added to the original statute. Subsequently, various amendments designed to strengthen or clarify the provisions of these various laws were enacted.

The Sale of Food and Drugs act, 1875, was the first comprehensive legislation dealing with adulteration. Many of the older statutes, particularly the Adulteration of Coffee act, 1718, the Adulteration of Tea and Coffee act, 1724, the Adulteration of Tea act, 1730, and the Adulteration of Tea act, 1776, were designed more to protect the revenue than to protect the public from fraud and danger to health. In fact it was not until the Bread act, 1836, that a definite departure was made from revenue protection to the protection of the health of the community.

The multiplicity of acts relating to adulteration and the need for revision of the act of 1875 led to the Food and Drugs act, 1928. This act consolidated and repealed the four principal acts bearing the title Sale of Food and Drugs acts; namely, those of 1875, 1879, 1899 and 1927, and the two Margarine and Butter acts of 1887 and 1907. The 1928 act placed responsibility for administration and enforcement of the law on the local authorities, designated "food and drug authorities," who appointed "sampling officers" and public analysts whose duty was to detect violations and present evidence. The penalties invoked for violation were quasicriminal in nature but did not relieve the offender from his ordinary liabilities at common law or under the law of contract.

Unfortunately, the 1928 act only partially relieved the confusion. Purveyors of foods were still subject to a dozen or more special laws and regulations, some dealing directly with adulteration, others passed as agriculture acts and still others falling in the general category of public health laws. Parliament was again called upon in 1938 to consider additional legislation to consolidate these related laws. In 1938 the Food and Drugs act was passed which consolidated, with certain amendments and additions, a number of miscellaneous acts relating to food and drugs. The acts consolidated were the Food and Drugs (Adulteration) act, 1928; the Knackers acts, 1786 and 1844; the Bread act, 1836; part of the Public Health act, 1875; the Milk and Dairies (Consolidation) act, 1915; the Milk and Dairies (Amendment) act, 1922; the Artificial Cream act, 1929; and part of the Public Health (London) act, 1936.

This act dealt principally with foods and was divided into six parts: part I dealt with the composition of food and drugs, unsound food, measures to prevent the contamination of food, notification of food poisoning and sale of meat from knackers' yards; part II with milk, dairies and artificial cream; part III related to bread, flour, margarine, butter, ice cream, horseflesh and shellfish; part IV to the importation of food; part V dealt with markets, slaughterhouses and cold-air stores and part VI with administration of the act, legal proceedings and other miscellaneous matters.

The Food and Drugs act, 1938, like its predecessors, did not define adulteration *per se,* but prohibited the addition of substances to foods so as to render the food injurious to health and prohibited the addition of any substance to a drug so as to affect injuriously its quality or potency. The act further prohibited the abstraction of any constituent of a food so as to affect injuriously the nature, substance or quality of the food, except that such altered food could be sold if the purchaser was advised of the alteration and the food complied with pertinent regulations governing food standards. Considerable attention was devoted to prescribing sanitary facilities in food-handling establishments and to prohibiting practices which might result in contamination of the food with filth, spoilage or other changes which might adversely affect its quality. Authority was provided for inspection, sampling and analysis of food; and penalties for violations of the statute and regulations were set forth. Medical practitioners were required to report in detail to the local authorities all cases of suspected food poisoning, and the appropriate local medical officers required to make suitable investigations of all such cases, placing the suspected food under an embargo until the investigation was completed

Milk and other dairy products were dealt with at length in the act of 1938. The minister of agriculture and fisheries was empowered to promulgate regulations defining adulteration of milk and the councils of counties and county boroughs to enforce the act, except in London where this power was placed in the hands of the food and drug authorities.

The enforcement of the Food and Drugs act, 1938, rested with the various local authorities and food and drug authorities, as defined in section 64. These authorities were, in general, the local county or borough councils. They were required to appoint qualified public analysts and provide facilities for bacteriological and other examinations of samples of food and drugs. Penalties were provided for violations of the act and legal procedure for prosecutions, appeals and other punitive measures were outlined.

**Legislation in the United States.**—The earliest enactment of the U.S. congress dealing with adulteration was the Flour Inspection Act for the County of Alexandria, in the District of Columbia, passed in 1824. Subsequently, congress enacted other local food and drug laws which applied principally to the District of Columbia and dealt with individual foods or drugs. The first general statute enacted by congress which dealt with adulteration was the Edwards bill of 1848 prohibiting the importation of adulterated drugs. It was not until 1890 that a similar bill, the Edmunds bill, prohibiting the importation of adulterated food, was enacted.

In 1880 a concerted attempt was made to enact legislation regulating interstate traffic in foods and drugs. Between 1880 and 1906 a total of 103 bills were introduced into congress, none of which was passed by both houses; but their various provisions set a pattern for the legislation which culminated in the Food and Drugs act of 1906. The factors responsible for the enactment of this act stemmed from a long series of investigations of adulteration of foods and drugs started by the department of agriculture in 1879. In 1880 Peter Collier, then chief chemist of the division of chemistry of the department of agriculture, recommended the enactment of a national food and drug law. He stated: "A law, carefully framed, is greatly needed in this country, where adulteration and substitution are every day practised." He further observed: "Laws should be made and vigorously enforced making the adulteration of foods and medicines a criminal offense. Where life and health are at stake, no specious arguments should prevent the speedy punishment of those unscrupulous men who are willing, for the sake of gain, to endanger the health of unsuspecting purchasers."

The man whose spectacular investigations so aroused public opinion that legislation was actively considered by congress was Dr. Harvey W. Wiley. Wiley became head of the division of chemistry in 1883 and immediately began a series of investigations on adulteration culminating in a series of reports characterized

by Pres. Grover Cleveland in 1888 as "the most complete treatise on that subject that has ever been published in any country." These investigations included a basic study of the addition of preservatives, colours and other substances to food and a study of methods to analyze foods and determine their adulteration. He organized among members of the bureau of chemistry (formerly the division of chemistry) the "poison squad" to which preservatives and other suspected adulterants were fed in order to determine their dietary value and harmful effects. Wiley also instituted a popular crusade, lecturing and writing for the popular press, organizing national pure food congresses and using every available means to arouse public opinion to promote legislation. So successful were his efforts that the Food and Drugs act was passed by congress by an overwhelming vote and signed by Pres. Theodore Roosevelt on June 30, 1906.

The act of 1906 set forth in rather specific language a statutory definition of adulteration. In the case of drugs recognized in the United States *Pharmacopoeia* or *National Formulary*, the standards set forth in these compendia were made yardsticks whereby the drugs were measured. Unfortunately, the act went on to specify that drugs could differ from these standards and not be deemed adulterated if the standard of strength, quality or purity were plainly stated on the label. Hence, persons ignorant of the significance of the standards could still purchase inferior articles, believing them to be of standard strength or quality. If a drug was not recognized in one of the official compendia, it was deemed to be adulterated if its strength or purity fell below the professed standard or quality under which it was sold. This provision was also open to abuse since it was not illegal to place two, three or more times the stated amounts of the ingredients in a drug preparation. In the case of potent or toxic drugs, serious reactions or poisoning could, and occasionally did, occur.

Confectionery was prohibited from containing terra alba, barytes, talc, chrome yellow or other mineral substances, or poisonous colour, flavour or other ingredients detrimental to health, or any vinous malt, spirituous liquor or compound or narcotic drug. Prior to the enactment of this law, the substances mentioned had been common adulterants of candy, and many children had been harmed or died as a result of consuming adulterated confections.

The adulteration of food was defined to prohibit the addition of substances which might reduce or lower or injuriously affect the quality or strength of the food; prohibit substitution, in whole or in part, of any substance; prohibit the abstraction of valuable constituents; prohibit the use of colour, coatings or other devices designed to conceal damage or inferiority; prohibit the addition of poisonous or deleterious ingredients; and prohibit filth and decomposition in food products.

Although these provisions seemed adequate in 1906, it soon became apparent that unscrupulous manufacturers could circumvent the purpose of the statute. For instance, foods which contained poisons which were natural ones rather than added during the course of production, processing or manufacture were exempt from punitive action. Foods which might become contaminated with dangerous disease organisms could be shipped with impunity if it could be shown that no filth or decomposition were present. One of the most serious loopholes in the law was the so-called "distinctive name" provision which provided that a food not containing an added poisonous or deleterious substance would not be deemed adulterated if sold under its own distinctive name. All an unscrupulous manufacturer needed to do was to adopt a distinctive name for the article; and he could, within limits, formulate any mixture he wished, vary the composition from day to day if he so desired and otherwise defraud the purchaser with impunity. This became a common practice in some quarters of the food industry.

The penalties provided by the statute for violation of its provisions were of two kinds. A criminal provision in section 2 provided a maximum fine of $200 for a first offense for interstate shipment of an adulterated or misbranded food or drug or the receipt thereof and the delivery or offer of delivery in the original unbroken package for pay or otherwise of the adulterated or misbranded article. Subsequent offenses carried a maximum penalty of $300 or a year's imprisonment or both.

Section 10 provided for the seizure of interstate shipments of adulterated or misbranded articles by the United States marshal upon court order issued on a writ of monition attested by the United States attorney. This procedure removed the offending articles from the channels of commerce pending litigation of the issues involved. The seizure provisions were directed against the offending goods, and the responsible person or persons could ignore the entire procedure if they so chose. No penalty, other than loss of the goods by condemnation and such unfavourable publicity as might occur, was assessed against the person or firm responsible for the violation. The penalty provided by the criminal statute was nominal in character, and some firms regarded it in the light of a license fee to do an illegal business.

Although the Food and Drugs act was amended several times during the 32 years it was in force, these amendments did not alter materially the provisions dealing with adulteration. The defects already mentioned and others relating to the misbranding provisions of the law became more serious as technological developments in the food industry and the pharmaceutical industry created problems not contemplated by the framers of the original act. The development of a wide variety of packaged, prepared, preserved and canned foods created numerous opportunities for fraudulent practices not covered by the existing laws; and these opportunities were quickly seized upon and exploited by the less scrupulous dealers. New and more potent drugs were discovered and their control required greater technical skill; their potentialities for harm, if improperly prepared, labelled or distributed, increased enormously. The act of 1906 was found to be inadequate to cope with these modern developments.

Beginning about 1933 a series of bills was introduced in congress under the sponsorship of Sen. Royal S. Copeland of New York, providing an entirely new food and drug law. Although considerable support for new legislation was received from consumer groups and the department of agriculture, a powerful lobby prevented the passage of any bill to alter the Food and Drugs act, and it was not until a major tragedy occurred in 1937 that public opinion became sufficiently aroused to force congress to enact remedial legislation.

During Sept. and Oct. 1937 at least 73 persons died after taking a drug known as "Elixir Sulfanilamide." According to the U.S. *Pharmacopoeia*, an elixir is an alcoholic solution, but the product distributed as "Elixir Sulfanilamide" consisted of sulfanilamide dissolved in diethylene glycol, a poison which produces profound kidney and liver damage. The Food and Drugs act contained no provisions prohibiting the distribution of poisonous or dangerous drugs. The definition of adulteration did not encompass the sophistication of this product, and it was only because the manufacturer chose to call this mixture an "elixir" rather than a "solution" that the Food and Drug administration could remove the offending article from the channels of commerce. This tragedy was widely publicized and was one of the important factors in securing enactment of the Federal Food, Drug and Cosmetic act which became law on June 25, 1938.

The Federal Food, Drug and Cosmetic act contained many provisions not found in its predecessor. It prohibited foods dangerous to health; it also prohibited foods, drugs or cosmetics in insanitary containers or contaminated because of insanitary conditions of preparation. Under the old law dangerous foods were prohibited only when the danger came from an added ingredient. Under the new law the food was prohibited if the dangerous ingredient was contained in the food.

Added poisons in food were permitted if addition was necessary in good manufacturing practice, and if the amount added was within tolerances established by the federal security administrator. Metallic trinkets and nonnutritive substances in confectionery were forbidden. The distinctive name and "compound" exemption of the 1906 act were omitted; hence foods with distinctive names were not exempt from adulteration or misbranding provisions of the act. Drugs purporting to be among those officially recognized under [illegible] of the U.S. *Pharmacopoeia*,

*Homeopathic Pharmacopoeia* or *National Formulary* had to have listed on their labels any differences of strength, quality or purity from the official standards laid down by these compendia. Slack filling of containers was prohibited and deceptive containers were prohibited.

The penalties for violation of the provisions of the new act were substantially increased over the old law and included seizure of the offending article, criminal prosecution of the responsible shipper with maximum penalties of a fine of $1,000 or a year in jail, or both, for each violation charged; and in the case of intentional fraud or a second offense, a fine as high as $10,000 or a jail sentence of three years or both could be imposed. In addition, the courts were empowered to issue injunctions restraining persons from further violations of the act.

The enforcement of the Federal Food, Drug and Cosmetic act rested with the administrator of the Federal Security agency. An integral part of this organization is the Food and Drug administration, headed by a commissioner, an associate commissioner and one or more assistant commissioners. In order to detect violations and to enforce the law more effectively, the United States was divided into three inspection districts with offices in New York city, Chicago and San Francisco. These districts were abandoned in 1948 and their administrative functions transferred to Washington Inspection stations consisting of offices and laboratories with a staff of inspectors, chemists and administrative personnel were set up in Atlanta, Baltimore, Boston, Buffalo, New York, Philadelphia, Chicago, Cincinnati, Kansas City, St. Louis, Minneapolis, New Orleans, Denver, Los Angeles, San Francisco and Seattle. In Washington, D.C., were located the administrative offices and certain technical divisions and their laboratories, comprising the cosmetic division, food division, chemistry division, medical division, microbiological division, division of antibiotics control, division of pharmacology, division of state co-operation and the vitamin division. These divisions were established to supply technical information needed for the enforcement of the law and for the promulgation of regulations.

When a violation of the act is suspected, samples of the offending goods, together with documentary records showing the interstate character of the shipment, are collected by the inspectors and transmitted to the station in the territory in which the shipment originated. Analysis of the sample may be made at the station or by a technical division in Washington. If a violation is detected, a recommendation for appropriate action is forwarded by the station to the administrative headquarters in Washington. If punitive action is warranted, a statement of the facts and a recommendation is forwarded to the appropriate U.S. attorney, whose duty is to prosecute the case in the district court of the United States. Trial by jury may be had upon election by the defendant. Appeal from an adverse decision may be made in appropriate circumstances to the higher courts by either party.

## ADULTERANTS

The oldest and most widely used adulterant is water. It is cheap, easily procurable and one of the most difficult substances to detect, particularly in food products whose natural composition is largely water. Milk, in particular, lends itself to adulteration with water; and in most countries local statutes or ordinances have been drafted to prohibit this type of adulteration, usually by providing for a minimum butter-fat content of whole milk.

**Preservatives.**—The use of preservatives in foods has been practised since time immemorial. Smoking, salting or drying of foodstuffs in order to preserve them was practised by ancient man and is still in use today. The use of chemical preservatives received an impetus during the last quarter of the 19th century when the growth of large cities necessitated the transportation of perishable foods over considerable distances. Modern methods of packing and canning removed the need for preservatives in most foods, but certain foods still require the addition of some substance to retard or prevent natural spoilage.

The use of harmless preservatives to prevent natural decomposition of certain foods may usually be regarded as a legitimate trade practice and does not result in an adulterated product. Nevertheless, the use of preservatives has been grossly abused, to the detriment of both the consumer and the legitimate producer The use of preservatives to conceal damage or inferiority is condemned by most statutes dealing with adulteration The use of toxic or potentially harmful chemicals as preserving agents is also subject to legal restrictions in most countries. Furthermore, quantities of chemical preservatives in one food may be harmless to the consumer but when added to the quantities found in other foods may lead to serious impairment of health. The presence of a fluorine-containing spray residue on apples may not be injurious if the quantity is less than five milligrams per pound, but if the consumer of the apples lives in an area where the water supply contains one milligram of fluorine in the average daily quantity of water consumed, mottling of the tooth enamel may occur In this instance drinking the water without consuming the apples would have no deleterious effect.

Good manufacturing practice may still require the use of preservatives. Thus, even the most rigid inspection of tomatoes used for catsup cannot prevent the introduction of mould spores into the product. It is necessary to use a preservative such as sodium benzoate to prevent the development of mouldy decomposition In most areas of the United States apples and pears cannot be grown successfully without the use of insecticidal sprays. Washing procedures which do not harm the harvested fruit do not remove all of the spray residue. Hence, it was necessary for the federal security administrator to establish maximum tolerances for the presence of certain potentially harmful ingredients of insecticidal sprays on these products.

In considering, therefore, whether the presence of a preservative results in the article's becoming adulterated, one must consider the nature of the preservative, the amount present, whether the use of the preservative could be avoided by good manufacturing practice and the purpose for which the preservative was added.

**Boric Acid.**—Formerly widely used, boric acid has been largely abandoned as a preservative in both the United States and Great Britain. Its use is deleterious to the consumer, and it has been used in foods for which no preservative was needed if satisfactory manufacturing procedures were followed. Boric acid or borax has been used as a preservative in butter, cream, ham, sausages, potted meats, cured fish and in home-canned fruits and vegetables. It is not an especially effective preservative and will not hide any traces of decomposition which have already taken place. Its use is unnecessary since the foods to which it has been added can be adequately protected from decomposition by careful preparation and adequate processing during manufacture.

Although large single doses of boric acid or borax may be ingested with impunity, smaller doses taken over a long period of time may produce deleterious effects. Amounts of one-half gram of boric acid are harmless, but larger doses, from two to five grams or more, may produce a gastroenteritis, kidney damage and collapse. The continued daily consumption of amounts as low as one-half gram, amounts which could conceivably be ingested during the winter months by a person subsisting on preserved foods, may lead to digestive disturbances, loss of weight and interference with absorption of protein and fat. The action of boric acid is cumulative and the symptoms are insidious. Doubtless many cases of chronic boric acid poisoning have gone undetected because of the vague nature of the symptoms. In persons with gastrointestinal disease or kidney disease, the effects of boric acid are intensified.

**Formaldehyde.**—Although wholly unsuited for food preservation, formaldehyde was at one time used as a preservative for milk. By mid-20th century, its use had been prohibited in most countries. Although it is an efficient antiseptic, it is quite irritant to mucous membranes and ingestion; even small quantities may lead to severe burning, gastritis and diarrhoea.

**Salicylic Acid.**—Salicylic acid in a concentration of 1 to 1,000 will inhibit the growth of moulds and yeasts. It has been used mainly in foods and beverages containing sugar and was used more extensively in Great Britain than in the United States, where benzoic acid or sodium benzoate became more popular. In the

quantities usually employed—namely 120 mg per pound in jams and 0 5 g per gallon in beverages—deleterious effects were not observed In large quantities, salicylic acid and its derivatives produce sedation and analgesia; but, unfortunately, nearly 60% of the persons to whom it is administered may show signs of salicylism which consist of tinnitis, deafness, headache, nausea and cardiovascular disturbances. Furthermore, many individuals show an idiosyncrasy to the salicylates which is often manifested by an urticaria and digestive disturbances, even following small amounts. Free salicylic acid may produce a mild gastritis because of its irritant properties

**Benzoic Acid.**—Closely related chemically to salicylic acid, benzoic acid, sodium benzoate and organic esters of benzoic acid have been employed extensively in the United States as preservatives Jams, jellies and catsup are the principal foods in which these preservatives are used. The amounts usually employed are innocuous, and these substances are considerably less harmful than the salicylates.

**Propionic Acid.**—The discovery that certain fatty acids are effective fungicidal agents led to their employment as mould inhibitors in food products. Because of its occurrence in natural foods and because of its innocuousness, propionic acid and its salt, sodium propionate, have been employed in the baking industry to inhibit mould growth in bread and pastries. Although this preservative is relatively harmless, its use may permit the unscrupulous dealer to sell old bread as fresh. It is principally on economic grounds that the use of propionic acid is frowned upon by regulatory authorities.

**Sulphurous Acid.**—Sulphurous acid, applied in the form of sulphur dioxide, was formerly used to preserve meat, beer, juices and dried fruits. Except in preserving dried fruits, the use of sulphurous acid or sulphur dioxide was superseded by other more efficient methods of preservation. In large quantities sulphurous acid or the sulphites may produce nephritis, but such quantities would not ordinarily be found in preserved foods and beverages.

**Monochloracetic Acid.**—About 1943 the citrus fruit growers of the United States discovered that monochloracetic acid in relatively small amounts would serve as an efficient preservative and stabilizer for citrus juices. Overripened fruit and fruit otherwise unfit for use could be converted into juice and its inferiority concealed to some extent by the use of preservatives Monochloracetic acid was found to be deleterious, and in 1945 an epidemic of vomiting and diarrhoea occurred which was associated with the drinking of an orange-type beverage containing this preservative. Its use in the United States was prohibited by the federal Food and Drug administration.

**Thiourea.**—Thiourea is an effective antioxidant and has been employed in pharmaceutical preparations, particularly in ampuled solutions of readily oxidizable drugs as a stabilizer. In 1944 and 1945 experiments by the citrus industry showed that dipping the fruit or spraying it with solutions containing 1% or 2% thiourea would prevent deterioration and preserve the vitamin C content. Unfortunately, it was discovered that the thiourea penetrated the skin of the fruit and, since it is a potentially toxic substance which inhibits bodily oxidation processes and decreases the functional activity of the thyroid, its use was proscribed by the Food and Drug administration.

**Spray Residues.**—The economical production of certain fruits such as apples, pears and peaches requires the use of insecticidal sprays to prevent damage to the crop by insect pests. Under optimum conditions it is not possible to remove all traces of the spray by washing or other means. However, it is possible, by proper procedures, to reduce the quantity of spray residue to levels which will not be injurious to the consumer. The principal substances used as insecticidal sprays are lead and arsenic in the form of lead arsenate, fluorine in the form of cryolite, DDT and other organic compounds such as parathion and benzene hexachloride. All these substances are poisonous if ingested; extraordinary precautions must be taken to keep the concentrations in foods below toxic levels; and, in most cases, none should be present in the finished product. The administrator of the Federal Security agency was empowered under the Federal Food, Drug and Cosmetic act to establish tolerances for poisonous substances when such substances cannot be avoided by good manufacturing practice In 1944 an order was issued by the administrator establishing a tolerance for fluorine remaining as a spray residue on apples and pears of seven milligrams per kilogram of fruit.

Informal tolerances for lead and arsenic spray residues were announced by the Food and Drug administration in 1940. The administration stated that it would not take action against products in which the concentration of lead was 0 025 gr. per pound or less and in which the concentration of arsenic was 0 01 gr. per pound or less. In 1945 the Food and Drug administration announced that no action would be taken against products containing DDT as a spray residue, provided the concentration of DDT did not exceed seven milligrams per kilogram of fruit.

**Other Adulterants.**—Although a wide variety of substances have been used by the unscrupulous to adulterate or debase foods, those employed successfully to any great extent are limited in number because of the ease with which many adulterants may be detected. During World War I and World War II, shortages of many essential foodstuffs developed, particularly sugar, fats and oils. The demand for these substances was met by profiteering manufacturers with a variety of cheap substitutes

Mineral oil was used to replace vegetable oil in salad dressings and other products in which the consumer would have difficulty in detecting the substitution. Some dealers sought to escape the penalties of the law by offering the products for special dietary use and extolling their virtues as nonfattening or as aids in reducing. The two principal objections to the substitution of mineral oil for vegetable oil are the nonnutritious nature of the mineral oil and the interference with the absorption of fat-soluble vitamins, particularly vitamins A and K, from the digestive tract. The use of mineral oil in foods was banned by the federal Food and Drug administration

Saccharin or other nonnutritive sweetening agents have been substituted for sugar in beverages, jams and other naturally sweet products. Although there is no evidence that small quantities of saccharin used are harmful, the loss of food value of sugar is of course economically and nutritionally harmful to the consumer.

Coffee became scarce during World War II, and a variety of substances were substituted in whole or in part for this material. Ground chick peas or ground cereals were the most frequent substitutes, often mixed with a little genuine coffee to provide a faint coffee-like aroma. Tea also has been subject to adulteration. In the United States during World War II, green tea was occasionally found to be nothing but dried grass. Other weeds, barks and plants were used to substitute for or "extend" the short supplies of tea. Shortages of chocolate and cocoa resulted in the adulteration of these products with ground cocoa shells and crude fibre. Starch was also used as an extender.

Drugs do not lend themselves readily to the same type of adulteration as does food. The usual complaint against drugs lies in deviations from standards of strength, quality or purity. Substitution of ingredients seldom occurs. However, in 1944 and 1945 it was discovered that a group of manufacturers of female sex hormones in New York city had devised a method of exploiting the premium price paid for natural estrogens. Natural estrogens consist largely of estrone with very small amounts of estradiol. Estradiol has from five to ten times the estrogenic activity of estrone and may be obtained from estrone by chemical reduction. Manufacturers were selling as natural estrogens, estradiol, made by reducing estrone, to which had been added an inert substance, cholesterol, to reduce the potency to that expected for natural estrogens. A given batch of natural estrogens then supplied from five to ten times as much of the adulterated product, and the substitution was extremely difficult to detect because of the close chemical and physiologic similarities of the products. This fraud was discovered and stopped by legal action of the Food and Drug administration.

**Colouring Matter.**—Artificial colours have both legitimate and illegitimate uses. Harmless colours are frequently used in confections, pastries and ice cream; and if their presence is declared, no deception of the consumer results. However, when an artificial

colour is used to mask inferiority or to imitate a superior and more costly article, the product must be considered adulterated.

Before modern methods of canning and quick freezing, fruits and vegetables were often treated with dyes or similar substances to restore the natural colour lost in processing. Such practices became rare, however, and are usually condemned by the authorities Milk has been coloured with annatto, tumeric and carrot juice to give it a creamy appearance, but most state laws prohibit this practice

Vegetable dyes are usually harmless, but their colours are often impermanent and may be altered by processing. Coal tar or aniline dyes are most frequently used for food colouring Many of these dyes are harmless; but some are potentially toxic, and their use is prohibited by law. Among the toxic dyes may be mentioned the paraphenylene diamine derivatives which may cause oedema of the face, throat and chest as well as severe skin rashes, and certain carcinogenic dyes such as butter yellow which was shown to cause cancer of the liver in experimental animals. In the United States all coal tar dyes must be certified as harmless by the Food and Drug administration before use.

## ARTICLES ADULTERATED

Although almost all foods lend themselves to some form of adulteration, certain foods, because of their economic importance, have been subject to this practice to a greater extent than others. A few typical modern examples are mentioned below.

**Milk.**—Four principal types of adulteration have been practised with respect to milk—addition of water, abstraction of butter fat in the form of cream, addition of a preservative and addition of colouring matter. The composition of whole milk is usually established by local authorities, and these forms of adulteration are universally prohibited. Addition of water and abstraction of butter fat may be readily detected by determinations of butter fat. Most localities require milk to contain at least 3% butter fat, although during certain seasons of the year some cows will give milk of a lower fat content. Large dairies make it a practice to blend milk so that the resultant product always has the same butter-fat content. Thus, rich creamy milk may be added to a milk low in fat to raise it to standard.

**Butter.**—Butter, like milk, is most often adulterated by abstraction of fat In the United States, butter is required to have a minimum fat content of 80%. Butter is also subject to adulteration with mould and filth. This occurs when dirty, partially decomposed or otherwise unfit cream is used in making butter. Such adulteration can usually only be detected by microscopic examination.

**Fats and Oils.**—Lard was subject to widespread adulteration between 1880 and 1890 when U.S. lard imported into England was found to consist largely of a mixture of real lard with cottonseed oil and beef-stearine. Other vegetable fats, such as maize oil, have been used to adulterate lard. Olive oil was frequently found to be adulterated during World War II, and products sold as olive oil often contained nothing but cottonseed or corn oil. Occasionally, even mineral oil was substituted in part for the vegetable oil. Salad dressings and other products composed chiefly of fats and oils have been the subject of fraudulent substitutions, such as the substitution of mineral oil for vegetable oils in these products.

**Flour and Bread.**—Bread is rarely adulterated in either the United States or England. Flour is often bleached by chemical means, the chief agents used being nitrogen peroxide, benzoyl peroxide, chlorine, bromine, nitrogen trichloride, acid calcium phosphate, acid ammonium phosphate and persulphates. Certain of these agents are objectionable because of the poisonous residues which may be left in the flour and because of their marked destruction of essential nutriments. Chlorine, nitrogen peroxide and benzoyl peroxide are among the bleaching agents to which objection has been made.

Because the production of white flour results in the loss of certain vitamins and minerals, encouragement has been given producers to restore the lost constituents. Under authority of the food standards section of the Federal Food, Drug and Cosmetic act, the federal security administrator established standards for the enrichment of wheat flour providing for the addition of the following substances in the amounts indicated.

| | Milligrams per Pound | |
|---|---|---|
| | Minimum | Maximum |
| Thiamin | 2 0 | 2 5 |
| Riboflavin | 1 2 | 1 5 |
| Niacin or niacin amide | 16.0 | 20 0 |
| Iron | 13 0 | 16 5 |
| Calcium | 500 0 | 1,500 0 |

"Enriched" flour must contain these ingredients in the quantities stated; but the addition of other ingredients, not mentioned in the standards, is prohibited even though they may be nutritious

**Tea.**—Instances of adulteration of tea have already been cited In the United States all tea is examined at the time of import and adulterated tea is refused entry. Although common at the turn of the 20th century, adulteration of tea later became rare.

**Coffee.**—Coffee beans are seldom adulterated, but ground coffee lends itself to the fraudulent addition of extenders, substitutes or other adulterants. Chicory, dried peas, caramel and other substances were used to stretch rationed supplies during World War II

**Cocoa and Chocolate.**—Starch in the form of sago flour or arrowroot has been used to adulterate cocoa powder. Red oxide of iron is added to colour the adulterated product and make it appear genuine. Cocoa shells, finely ground or pulverized fibre, are also used to adulterate cocoa.

**Beer.**—Beer was the subject of a famous instance of adulteration which resulted in important legislation in England. In June 1900 there occurred, mainly in the Midlands but also in other parts of England and Wales, an outbreak of an illness variously described as alcoholism, peripheral neuritis or multiple neuritis About 6,000 persons were affected, of whom about 70 died All were beer drinkers; and, after considerable time, Dr E. S. Reynolds of Manchester discovered dangerous quantities of arsenic in the beer. The brewing sugars used by the affected breweries all came from a single source This supplier used sulphuric acid made from highly arsenical iron pyrites during the manufacture of the sugar, and the resultant product was often contaminated with as much as four grains of arsenic per pound.

**Vinegar.**—The principal adulterant of vinegar is acetic acid. Vinegars may be malt or cider vinegars and may be flavoured with herbs such as tarragon. Formerly, much cider vinegar was merely dilute acetic acid, but such forms of adulteration are no longer widely practised.

**Baby Foods.**—Fruits and vegetables intended for infant feeding are chopped and passed through strainers. This so alters their appearance that adulteration by substitution of an inferior grade of produce is difficult to detect. In the case of string beans, carrots, beets and certain other vegetables, microscopic examination may reveal a high proportion of fibrous material, indicating overripe or inferior grades of produce. Bacteriologic and other tests may occasionally reveal the presence of mould or other contamination. Fortunately, vigilance on the part of food and drug authorities keeps this form of adulteration to a minimum.

**Confections.**—Candy has been subject to several forms of adulteration. The chocolate of chocolate coatings is frequently adulterated with paraffin, gelatin or some other cheap extender. Beet sugar or corn syrup is frequently substituted for cane sugar. Starch, gelatin and other substances may be added to fillers in excessive quantities.

Although not strictly a confection, popcorn was the subject of a novel form of adulteration in 1945. A brand of popcorn, widely distributed in the middle western United States, was found to have as much as half its weight made up of mineral oil. Seizure of the product and prosecution of the shipper effectively halted this form of adulteration.

**Nonalcoholic Beverages.**—Soda water, fruit drinks and similar beverages have been the subject of fraudulent adulteration. Grape juice preparations that have never seen a grape, orange drinks that are orange only in colour and beverages in which

saccharin has been substituted for sugar have found their way on the market. Fortunately, however, the instances of such fraudulent acts decreased because of effective law enforcement.

**Other Foods.**—Maple syrups have frequently been adulterated in two different fashions. Pure maple syrup may contain lead derived from the containers used in processing. Modern methods of preparation have largely overcome this dangerous form of adulteration. On the other hand, not infrequently has a mixture of cane or corn syrup with artificial maple flavouring been passed off as "pure Vermont Maple Syrup."

Spices have been subject to adulteration since ancient times and unfortunately, this practice continued In 1946, for example, shipments of black pepper were found to contain large quantities of buckwheat, cottonseed hulls and soybean meal. Horse-radish has been found to contain ground parsnips, and cinnamon bark derived from anything but cinnamon trees resembled the genuine article only in appearance. A shortage of Dutch blue poppy seeds in 1945 resulted in the marketing of India white poppy seed artificially coloured to simulate the more valuable article

**Drugs.**—Drugs are rarely the subject of deliberate adulteration although prior to the passage of the Food and Drugs act of 1906, the United States was flooded with fraudulent cures for the "dope habit" which contained large quantities of morphine or heroin, and with "liquor cures" which were notable for their high alcoholic content. Most cases of adulteration in modern times result from accident and are infrequent One or two such accidents may be cited to illustrate the importance of proper manufacturing controls to prevent accidental contamination.

In late 1940 and early 1941 a large pharmaceutical firm in the United States distributed tablets of sulfathiazole which had become contaminated with phenobarbital, a powerful sleeping drug. At least five persons died directly or indirectly as a result of the administration of these tablets. The accident occurred through the accidental introduction of several scoops of phenobarbital, which was being manufactured simultaneously with the sulfathiazole, into the machine compressing the sulfathiazole tablets. As a result of this accident the firm redesigned its manufacturing quarters so that it would be physically impossible for such an accident to reoccur.

In 1943 a large chemical house inadvertently labelled a drum of cadmium chloride, a poisonous chemical, as calcium chloride. This drum was shipped to a bakery which used calcium chloride for enriching bread. Fortunately, this mislabelling was discovered in time to prevent a serious adulteration.

During World War II a serious shortage of quinine developed since most of the world supply had fallen into the hands of the Japanese. Efforts were made to secure cinchona bark from South America In an effort to capitalize on the demand, unscrupulous South American dealers shipped bark from any tree available, labelling it "cinchona bark." It became necessary for the U.S. government to send analysts to South America to do spot assays on bark submitted for shipment.

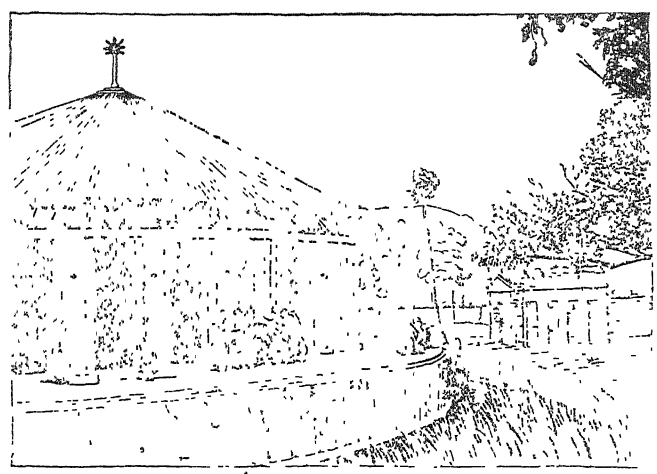
Imported crude botanical drugs may be adulterated. Senna, aloes and similar products are sometimes extended by admixture with seeds, straw, fibre, leaves and roots from other plants. Since such shipments are usually inspected and assayed before being passed through customs, the adulteration is detected and entry denied.

For the first time the act of 1938 provided control over adulterated cosmetics. Serious injury to users had occurred in the late 1920s and early 1930s from eyelash dyes containing coal tar dyes. The act of 1938 provided, among other things, that coal tar hair dyes bear a conspicuous statement on the label warning against use in or around the eyes. Poisonous or deleterious ingredients in cosmetics were also prohibited.

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**ADULTERY**, the sexual intercourse of a married person with another than the offender's husband or wife (from Lat *adulterium*). Among the Greeks, and in the earlier period of Roman law, it was not adultery unless a married woman was the offender. The foundation of the later Roman law with regard to adultery was the *lex Iulia de adulteriis coercendis* passed by Augustus about 17 B.C (See *Dig.* 48, 5; Paull. *Rec. Sent.* II. 26; Brisson, *Ad Leg. Iul de Adult.*) (*See* DIVORCE.)

**ADUWA** (also called Adowa), in the province of Tigré, Ethiopia, 145 mi. northeast of Gondar and 17 mi. east by north of Aksum, the ancient capital of Ethiopia. Aduwa, a hill slope at an elevation of 6,500 ft., in a rich agricultural district, is an important market centre Pop. 6,500 (est.). On a hill about 2½ mi. northwest of Aduwa are the ruins of Fremona, the headquarters of the Portuguese Jesuits who lived in Ethiopia during the 16th and 17th centuries.



ADUWA, CAPITAL OF TIGRÉ, IS THE CHIEF CENTRE OF TRADE BETWEEN CENTRAL ETHIOPIA AND THE COAST HERE IS SHOWN THE CHURCH OF THE SAVIOUR OF THE WORLD

An Italian invading force was crushed near Aduwa on March 1, 1896. In Oct. 1935 the Italians evened the score by bombing and then capturing the town. It was recaptured by British and Ethiopian troops in April 1941. (*See* ITALY: *Hist.*; ABYSSINIA. *Hist.*)

**AD VALOREM.** The term appropriately used in commerce for a duty which is levied by customs authorities on goods or commodities "according to value." An ad valorem duty is the opposite of a "specific" duty, which is chargeable on the measure or weight of goods. The early English customs tax called "poundage" was an ad valorem duty levied at the rate of one shilling in the pound, or five per cent. In Great Britain in 1927 the duties, commonly called "McKenna Duties," on motor cars, musical instruments, etc., and most of those under the Safeguarding of Industries act, were on an ad valorem basis, and duties of this description were also levied in several British overseas dominions and in the United States of America; in some cases a combined specific and ad valorem duty was leviable, particularly in the United States.

The general practice in the United States is that duty is levied on the foreign export value, *i.e.*, the actual cost at the place of purchase, or the home consumption value in the exporting country, whichever is the greater. It is usual to require at the port of entry the production of an invoice with full particulars of the place where, time when, and the person from whom the goods were purchased, and the actual cost of the goods and any charges on them. Such invoice has to be countersigned by the U.S. consular officer for the district from which the goods are actually destined for the U.S., *i.e.*, place of consignment, not place of shipment. On arrival at the U.S. port of entry the invoice is sworn to by the importer. The definite establishment of the dutiable value is then decided upon by the appraisers at the port of entry, appeal lying to the customs court, formerly the board of general appraisers.

In the British overseas dominions ad valorem duties are usually assessed on the value of the goods in the home trade of the exporting country. In some countries, although nominally ad valorem duties are imposed by the tariff, in practice arbitrary unit values are fixed, either periodically as in the case of Egypt or permanently as in the case of Argentina; the prescribed ad valorem duty is levied on these arbitrary valuations, thus in effect making the duties specific.

It has been argued that, theoretically, an ad valorem duty is preferable to a specific duty, inasmuch as it falls in proper proportion alike on the high-priced and low-priced grades of a commodity, and no matter how the value of any article fluctuates the rate of taxation automatically adjusts itself to the new value. This adjustment has been of particular importance in countries where the currency has been subject to violent fluctuations or where prices have been notably unstable. In practice, however, ad valorem duties may lead to great inequalities and are also difficult to assess equitably; while the relative value of two commodities may remain relatively unchanged under an ad valorem duty, yet owing to the difference in the cost of production, or through the different proportions of fixed and circulating capital employed in their manufacture, an ad valorem tax will be felt much more severely by one commodity than another, from the exporter's point of view. Again, there is always a difficulty in obtaining a true valuation of the exported goods, for values from their very nature are variable.

Ad valorem fees are imposed by some countries (mostly Latin American) on the consular certification of invoices, which are necessary for the clearance of goods through the customs on arrival at the port of destination. These range from 2% to 10%.

The term ad valorem is also used for British stamp duties. By the Stamp Act of 1891, certain classes of instruments, *e g*, bills of exchange, conveyances or transfers, leases, mortgages, etc, must be stamped in England with the proper ad valorem duty, that is, the duty chargeable according to the value of the subject-matter of the particular instrument or writing. (*See* SAFEGUARDING OF INDUSTRY; STAMP DUTY; TARIFFS.)

**ADVANCED GUARD,** the protective detachment pushed forward in advance of an army, or smaller force, moving towards the enemy. Although protective in purpose, its action is largely offensive in order to fulfil its duties. These are to gain information of the position and strength of the enemy's main forces, to deny similar information to the enemy's reconnoitring troops, to brush aside his advanced detachments and so prevent delay to the march of the main body. When the advanced guard eventually comes to grips with the real strength of the enemy, it should fix him securely in order to allow its own main force to deploy and manoeuvre. Gaining time is then as vital as saving time in the earlier phase, and for this purpose the advanced guard may have to resort to attack, defence, or an alternation of both.

The rôle of an advanced guard may be likened to that of an outstretched arm of a man moving in the dark. Flank guards and rear guards are variations of an advanced guard whose names explain their rôles. Outposts are a protective detachment to a force halted.

**ADVANCEMENT,** a term used in English law to describe a sum of money or other benefit conferred by a father or a person *in loco parentis* upon a child by blood or adoption for the purpose of establishing such child in life. It may be considered thus:

1. Advancements during a father's life when the father dies intestate. The law as to this is of very ancient origin but is now summed up for our purpose in ss. 47 1 (iii.) and 49 (a) of the Administration of Estates Act 1925. By the former, when a person who dies intestate has during his life paid money or transferred property to a child of his by way of advancement, or has settled money or property on a child of his on such child's marriage, then, if on the parent's death intestate the child is entitled to a share of the parent's estate, the money or property advanced or settled is to be taken *prima facie* as being so paid or settled in and towards the satisfaction of such child's share of the estate as one of the next of kin, and must be taken into account in apportionating the estate among the issue of the intestate. The value of the advancement is what it is worth at the death of the intestate. By s. 49 (a), where a testator dies partially intestate, any benefits given to the issue of the testator by the will are to be brought into account as if they were advancements in distributing the undisposed of estate among such issue.

2. Double portions. The provisions of s. 49 (a) are really an adaptation of the equitable rule against double portions to cases of partial intestacy. By that rule, where a father or person *in loco parentis* by his will leaves a legacy to a child by blood or adoption and afterwards gives an advancement to such child, then if the advancement was of property of a similar description to that given by the will, the advancement is *prima facie* to be taken as an ademption, total or *pro tanto*, of the legacy. In the same way if the deceased has before he made his will covenanted to advance a certain sum to the child, then if not having made the advancement during his life, he by his will leaves a legacy to the child, or if he dies intestate and the child is entitled to a share of his estate as next of kin, the legacy or the share of the estate is to be taken into account in total or *pro tanto* satisfaction of the debt due by the covenant.

3. Formerly advancements out of the capital of property held in trust for sale for persons absolutely or contingently entitled could only be made by direction of the court. Now they may be made by the trustees at their absolute discretion, provided that no more than one half part of the cestui que trust's actual and prospective share is so advanced, that if the person advanced becomes absolutely entitled to a share of the trust property the amount advanced shall be taken into account, and that no interest in the trust property taking precedence of his share shall be prejudiced by such advancement without the owner's consent in writing (*see* the Trustee Act 1925, s. 32).

**ADVANTAGE,** that which gives gain or helps forward in any way (Fr. *avant*, before). It is often contracted to "vantage." In some games (*e.g.*, lawn tennis) the term "vantage" is used technically in scoring. A position which gives a better chance of success than its surroundings is called a "vantage ground." The term "point of vantage" is used in sport, also generally, to set forth the occupancy, or attainment, of a favourable position for competitive operations of whatever sort.

**ADVANTAGE, MECHANICAL.** Mechanical advantage is obtained by using a machine which exerts a *force* greater than the force applied, and is expressed by the ratio $\frac{\text{force obtained}}{\text{force applied}}$. "Machine" is here used in its widest sense, the simplest form being the lever. (*See* MECHANICS.)

**ADVENT** (Lat. *Adventus*, sc. *Redemptoris*, "the coming of the Saviour"), a holy season of the Christian Church, the period of preparation for the celebration of the nativity or Christmas. In the Ethiopic Church it lasts from Nov. 11, in other churches from the Sunday nearest to Nov. 30, till Christmas. It is uncertain at what date the season began to be observed. A council at Saragossa in 380 forbade the faithful to be absent from church from Dec. 17 to Epiphany; but the first unquestionable mention of Advent is at the Council of Tours (567). It has long been recognized in the West as the beginning of the ecclesiastical year. The Roman Catholic Church forbids the solemnization of marriage during Advent. In many countries Advent was marked by diverse popular observances, some of which still survive. In some parts of England poor women used to carry round the "Advent images," two dolls dressed to represent Christ and the Virgin Mary, visiting every household and demanding halfpence. In Normandy the farmers still employ children under 12 to run with torches through the fields and orchards setting fire to bundles of straw to drive out vermin. In Italy the last days of Advent are marked by the entry into Rome of the Calabrian pifferari who play bagpipes before the shrines of the Holy Mother (as the shepherds of Bethlehem are believed to have done before the infant Saviour).

**ADVENTISTS, SECOND,** members of religious bodies whose distinctive feature is a belief in the imminent physical return of Jesus Christ. (*See* also ESCHATOLOGY.)

**ADVENTITIOUS,** coming from outside, in no sense part of the substance or circumstance (Lat. *adventicius*, coming from

abroad). Carlyle called a man's clothes, or condition of life "adventitious wrappages," as being superadded and not a natural part of him. In botany the word means "out of the usual place," as a root or a bud arising at a point not normal for it.

**ADVENTURE,** a hazardous enterprise. Thus an "adventurer," from meaning one who takes part in some speculative course of action, came to mean one who lived by his wits and a person of no character. The word is also used in certain restricted legal connections. *Joint adventure,* for instance, may be distinguished from partnership (*q.v.*). The *bill of gross adventure* in French maritime law is an instrument making a loan on maritime security. The word was freely used of mercantile enterprises during the colonizing period: hence the title of "Merchant Adventurers." (*See* CHARTERED COMPANIES.)

**ADVERB,** a part of speech modifying or qualifying an adjective, verb or other adverb. According to their function they are divided into adverbs of time, place, quantity, manner, etc.

**ADVERTISING,** the process of disseminating information for commercial purposes. Advertisement has existed from early times. Traders made themselves known and called attention to their products by mural inscriptions before the age of printing: a papyrus, discovered at Thebes offering a reward for a runaway slave, is reputed to be 3,000 years old

The public crier, a civic institution in ancient Greece, is not yet extinct. In the middle ages the spoken word was almost the only mode of publicity in use. The invention of printing ushered in the modern period of advertising. The Bodleian library has a small poster or broadside by William Caxton, 7in. by 5in., advertising a service-book, "The Pyes of Salisbury Use" for sale at the Red Pole in the almonry of Westminster. It was issued in 1480. Printing alone made possible the transition from simple announcement to the system of argument and suggestion which constitutes modern advertising, and the medium of this development was the newspaper. The *Mercuries* or weekly papers sometimes carried a few advertisements, including the first offerings of coffee (1652), chocolate (1657) and tea (1658).

In June 1666 the *London Gazette,* No. 62, announced the first advertisement-supplement, as follows: "An Advertisement—Being daily prest to the publication of Books, Medicines, and other things not properly the business of a Paper of Intelligence. This is to notifie once for all, that we will not charge the *Gazette* with Advertisements, unless they be matter of state; but that a Paper of Advertisements will be forthwith printed apart, and recommended to the Publick by another hand."

In No. 94 of the same journal, published in Oct. 1666, there appeared a suggestion that sufferers from the Great Fire of London should avail themselves of this means of publicity: "Such as have settled in new habitations since the late Fire and desire for the convenience of their correspondence to publish the place of their present abode, or to give Notice of Goods lost or found, may repair to the corner House in Bloomsbury on the East Side of the Great Square, before the House of the Right Honourable of the Lord Treasurer, where there is care taken for the Receipt and Publication of such Advertisements."

Clearly, the restriction of the word "advertisement," which for Shakespeare and the translators of the Authorized Version had meant information of any kind, to a business announcement was in *The Tatler* of Sept. 14, 1710:

"It is my custom, in a dearth of News, to entertain myself with those Collections of Advertisements that appear at the end of all our Publick Prints. . . . Advertisements are of great use to the vulgar. First of all, as they are instruments of ambition. A man that is by no means big enough for the *Gazette* may easily creep into the advertisements. . . . A second use which this sort of writings have been turned to of late Years, has been the management of Controversy. . . . The inventors of *Strops for Razors* have written against one another in this way for several years. The third and last of these writings is to inform the World where they may be furnished with almost everything that is necessary for Life. If a Man has Pains in His head, Cholic in his Bowels, or spots in his Cloathes, he may here meet with proper Cures and Remedies If a Man would recover a Wife or a Horse that is stolen or strayed, if he wants new Sermons, Electuaries, Asses' milk, or anything else, either for his Body or his Mind, this is the place to look for them in."

By the middle of the century, advertising began to be complained of, and the stains which the practice of that age left upon its reputation are not yet quite obliterated. In *The Idler* Jan. 20, 1758, Dr. Johnson has:

"Advertisements are now so numerous that they are very negligently perused, and it is therefore become necessary to gain attention by magnificence of promises and by eloquence sometimes sublime and sometimes pathetick. Promise, large promise, is the soul of an advertisement. I remember a washball that had a quality truly wonderful—it gave *an exquisite edge to the razor!* . . . The trade of advertising is now so near to perfection that it is not easy to propose any improvement."

## PSYCHOLOGY OF ADVERTISING

The psychology of advertising embraces the application of modern psychology to the problems of advertising. Every effect has a cause: human behaviour is just as susceptible of interpretation in terms of cause and effect as are the movements of the heavenly bodies. To understand behaviour one needs to understand its causes, and to control behaviour one needs to get control of its causes. The control of human behaviour in the purchase of goods is the ultimate aim of the advertiser.

**Dynamic Psychology** has disclosed the driving forces of the human machine to be motives, desires, needs and wants. Thus, human beings want food and drink, rest and comfort, protection from danger, comradeship with their fellows, superiority over their rivals, etc. The universal presence of these needs or desires guarantees that only relatively slight stimuli need be applied to set the human being into action in order to satisfy them. The advertiser, knowing these facts, attempts not only to engender action by playing upon these motives, but also to show that his own product will satisfy a fundamental need *more effectively* than any other competing product. We find, therefore, that such a commodity as a tooth paste will be offered as a means of satisfying the desire for cleanliness, for beauty, for protection from disease, for prestige, for success in love, or in business. Other things being equal, that commodity which stimulates into action the most powerful motive will win the market. The use of argument and logic plays a minor role in successful present-day advertising in comparison with the direct appeal to desire.

After the proper appeal is chosen the advertiser is faced with the necessity of presenting it to his readers most effectively. At every step in this process psychological problems are encountered. For instance, in order to attract and hold attention the advertisement must be different from its neighbours; it must be *distinctive.* Now, distinction of a given amount may be attained in a variety of ways and at varying cost, for example, by the use of a large space or by associating it with a novel radio program. But when full-page advertisements are too common, and the use of a given radio technique is too nearly universal, both these devices lose their power of grasping the attention. Many other psychological ways of making the appeal effective are known, such as the influence of a pleasant state of mind, however it may be created, upon the memory; the dependence of the comprehension of a message upon the intelligence level of its readers; the dependence of the effectiveness of the trade names and trade marks of commodities, of packages and other containers upon the ability of the reader to discriminate between them and those of competitors and imitators. All these matters of attention value, of aesthetic quality, of ease of comprehension, of freedom from confusion with imitations and many others have been measured by methods developed in the psychological laboratory. For instance, an adaptation of the familiar free association test has been employed to measure the influence of years of advertising upon the familiarity of certain commodities, trade names and slogans in the minds of the public. By presenting a series of commodity names to a sampling of consumers with the request that they report the first thing suggested

by each, it has been possible not only to determine the relative familiarity of products in the minds of people, but to analyze some of the most important factors that determined their status. On the basis of the intelligence surveys that have been made of the population of the U.S., the advertiser can adjust his story so as to be intelligible to any desired proportion of the population. Any advertising message that is to reach as many as three-fourths of the people of the United States must be expressed in the simplest possible words, with short uncomplicated sentences and, if printed, with the use of pictures whenever feasible.

**Choice of a Medium and a Product.**—The choice of the medium in which the advertisement shall appear, whether it be radio or television, billboard, newspaper, magazine or handbill, and the place where it shall appear in that medium are dependent upon such psychological factors as attitude and interest Is the hurried reader of a morning newspaper in the attitude favourable to the purchase of an article, or is the television viewer sitting in a comfortable chair at home in the evening in a more appropriate attitude? What is the most appropriate time and place to make a favourable impression upon the professional man, the financier, the merchant or the labourer?

More fundamental than all of these matters of the choice of an appeal and its presentation is the part that psychology may play in determining the nature of the actual product to be sold. It is, indeed, no longer necessary to guess at the popular taste. It may be measured upon a sampling of the buying public. The pleasingness of a proposed brand of coffee, a pattern of linoleum, a musical composition or a perfume, as well as the name that shall be given to it, can be, and occasionally is, determined before it is put upon the market through the simple process of taking a census of preferences.

The technique of measuring such subjective data as preferences, likes and dislikes, as developed in the psychological laboratory, is simple and applicable to an almost unlimited range of practical business problems.

**Experimental Studies of Advertising Psychology.**—The earliest studies of advertising problems dealt with attention and how to attract it, as this was considered the primary requisite of successful advertising. Such questions as how big an advertisement should be, how frequently it should be repeated, what colours had proven attention value, and what part of the printed page attracted the most attention were examined in the psychological laboratory (H. Gale, *On the Psychology of Advertising; Psychological Studies,* University of Minnesota, 1900). Problems of the memory value of advertising were then attacked as second only in importance to attention value. For this purpose the laboratory methods for measuring recall, recognition and retention were adopted outright, or in slightly modified form (W. D. Scott, *The Theory of Advertising,* 1903, and H. L. Hollingworth, *Advertising and Selling,* 1913). The application of the "order of merit method" of James Cattell for measuring the value of a whole advertisement introduced a long series of researches of this nature, which have had a profound effect upon the content of the psychology of advertising (E. K. Strong, *The Relative Merit of Advertisements,* 1911).

In later years more complex and less tangible factors affecting advertising success were subjected to experiment. For example, the power of the reader to discriminate among various commodities, advertisements, trade names, etc., was tested with interesting results (R. H. Paynter, *A Psychological Study of Trade-Mark Infringement,* 1920). The feelings and faint emotional states aroused by advertisements and their various components together with the factors that create and strengthen belief, such as positive and negative suggestion, were also measured and evaluated. (*See* A. T. Poffenberger, *Psychology in Advertising,* 1925.) Radio and television advertising was intensively studied by the above techniques or slight modifications of them. Such problems as the measurement of entertainment value of a program, its effectiveness in making a product known, the measurement of value of special features of a program, and the determination of listening habits were partially solved.

(A. T. P.; X.)

## COLOUR IN ADVERTISING

Colour in advertising is as old as the painted signs of inns and shops. Commercial signs and business announcements created by the artist's brush go back several centuries The lithographed poster for advertising purposes, as used in the modern sense, started with Jules Cheret about 1867. In printing (q.v.) the first colour advertisement was for a rug, and was prepared by one of the large mail-order houses. The coloured electric sign followed close on the development of the incandescent lamp about the beginning of the 20th century. The coloured tube lighting (the neon vacuum coloured tube) came into vogue about 1925, and largely revolutionized electrical display signs.

It was the half-tone engraving, when developed into process printing, that made the use of colour practical for periodicals, catalogues, and other forms of printing, but because of mechanical difficulties it was not until about 1910 that the use of colour became common in publication advertising. New iridescent inks that would fuse without blotting out certain tones, highly surfaced papers, and printing presses that would register perfectly all had to be developed before colour advertising became practical About 1920 the first rotary printing press was perfected for process coloured productions. Not until 1937 were the mechanical difficulties overcome to such an extent that it was economically practical to print fractional page magazine advertisements in colour Thereafter it was not unusual to find fully one-half of the advertising space in periodicals printed in colour.

Posters and car and bus (or tram) advertising is more than 90% coloured. Owing to the fact that most poster printing is done by lithography, and that lithography developed colour processing long before it was practical on the letterpress, that form of advertising has practically always been in colour

The first use of colour in advertising was to attract the attention of the reader, but laboratory tests have indicated that adding colour increases the attention value of a display on a magazine page only 13%. As the extra cost of printing in colour is more than 13%, that was unprofitable.

Colour advertising has been strikingly successful: (1) in portraying goods in their actual colours, (2) in giving various articles a setting of richness and a refined atmosphere, (3) in showing the appearance of the package or container, (4) in reproducing trade marks or other distinguishing features.

Colour in advertising is probably a cause as well as an effect of the greatly increased use of colour in dress, in furnishing and decorating the home, in the variety of tones in which automobiles are painted, and even in the selection of finishing materials by architects. New colours in all these applications were so attractively displayed in advertising that the vogue for colour was sped and spread by their vivid illustrations.

As colour advertising became an important commercial factor, psychologists carried on extensive investigations to determine colour preferences, but without much success, in so far as their researches could be applied to advertising. That cool colours—blues and greens—are more attractive for such displays as window trimming in hot weather than reds, yellows and oranges has been shown. That the reverse is true only to a slight degree is something of an anomaly. This same principle has been successful in advertising for summer and winter resorts.

That women once preferred red and men blue was demonstrated for wearing apparel, but it is probably true that tastes have changed. As many red neckties as blue are sold by haberdashers, and more blue than red hats by milliners.

That there is a physiological as well as psychological effect of colour, seems to be established by such popular expressions as "feeling blue," a "gray day," "dark hours," "a drab existence." Also there is the acknowledgment adopted by accountants centuries ago of using blue for the debtor side of the ledger and red for the credit side, as those tones were supposed to be symptomatic of the feelings when incurring and discharging debt.

Psychologists have established helpful combinations of colours in producing the maximum luminosity. The two colours which stand at the top for legibility for the greatest distance are black and yellow; the latter as background. Black on white is the next

most luminous combination.

Also the cool colours used for tinting the walls of a room make it look larger than if in white. Red or yellow make it seem smaller than white. (H. E. A.; X.)

## UNITED STATES

In the United States, the first newspaper was entitled *Publick Occurrences both Foreign and Domestick*, published in Boston in 1690. This was succeeded in 1704 by *The Boston News Letter*, a weekly publication. The first issue of *The Boston News Letter*, published April 26, 1704, contained advertisements. It was 40 years before this publication reached a circulation of 300 copies per issue The early history of advertising, together with numerous sample advertisements of this early period, is well presented in Henry Sampson's *History of Advertising from the Earliest Times* (London, 1875).

The modern period may be dated from about 1850. The reason for putting the dividing point between the early and modern periods at 1850 is the rapid appearance of newspapers and magazines, which made possible the development of modern advertising on a large scale. Advertising was impossible until printing developed and until people generally learned to read One reason for the rapid increase in the number and distribution of advertising media at this time is probably to be found in the development of transportation systems—railways and waterways. Prior to that time railway lines were limited to restricted areas. There was no national transportation system. To illustrate the difficulties of transportation before that time, and even up to 1870 or 1875, we may quote the following announcement of the *Kenosha Telegraph* (Wis.) in Rowell's *Directory* in 1869:

> The town is renowned for the manufacture of wagons, which find a market all the way to the Rocky Mountains, and even to Oregon, being shipped by way of New York.

This shows how difficult it was to distribute goods generally over the country. It is obvious, then, that without the possibility of transporting goods there was no need of advertising media of wide circulation, and furthermore media could not develop a wide circulation because they could not be distributed conveniently or rapidly. During the middle and latter part of the 19th century the development of a national transportation system made possible the ready distribution of goods and publications. About this time also advertising agencies arose whose primary purpose was to serve as brokers of advertising space. They were rather different in this respect from the modern advertising agency, which, in addition to contracting for space, is, in its best form, an organization giving expert counsel and service regarding marketing and advertising plans and methods.

During this period the number of magazines and newspapers grew very rapidly, so that in 1861 there were 5,203 magazines, papers and periodicals of all kinds in the United States. Yet advertising was relatively limited as compared with the modern day. *Harper's Magazine* had its first advertisement in 1864; *Scribner's* in 1872. Magazine advertising on a large scale did not begin until about 1860 to 1870. It was stated in 1926 that *Harper's Magazine* had approximately as many pages of advertising in one year as it had in its first 24 years. At first it was used chiefly as a medium for advertising the Harper publications. Advertising rates at that time began to assume real proportions. *Harper's Weekly* was receiving $35 an inch for its back page in the 1860s.

The first advertising agency was established in Philadelphia in about 1840 by Volney B. Palmer. Later, offices were established in Boston and New York. Rates and contracts were not standardized at that time. The agent contracted for a certain amount of space with a publication and then sold it for whatever he could, receiving sometimes as high as 50% of the cost of the space as his commission. Among the better known early advertising agents were V. B. Palmer, S. M. Pettengill and George P. Rowell. In 1948, according to the U.S. census of business, the United States had 3,279 advertising agencies. About 255, including most of the larger ones, were members of the American Association of Advertising Agencies. (*See* ADVERTISING AGENT or AGENCY.)

**Development of Higher Standards.**—After 1911 advertising developed most rapidly as a standardized business. It was in that year that definite organized steps were taken to forward the movement of truth in advertising In 1911 counsel for *Printers' Ink*, a leading advertising journal in the United States, formulated what became known as "The Printers' Ink Model Statute," which was adopted in a large number of states. This statute made dishonest advertising a misdemeanour.

It (1) placed the responsibility for deception upon the advertiser, (2) dealt with questions of facts about goods rather than opinions, and (3) designated the making of untruthful, deceptive or misleading statements a misdemeanour. By Dec. 1951 this statute had been adopted in 26 states and the District of Columbia in substantially the form in which it was originally prepared by counsel for *Printers' Ink*, and in 17 states in modified form.

The adoption of this statute was a powerful force in bringing deception, misrepresentation and dishonesty in advertising under legal control. The Advertising Federation of America and local advertising clubs and other organizations became active in pushing the adoption of this or similar legislation, which exerted a powerful influence toward the remedying of objectionable practices. In addition to state legislation a number of larger cities adopted ordinances to check certain undesirable advertising practices.

About 1912, the Associated Advertising Clubs of the World at their annual convention adopted the motto "truth in advertising," and established a National Vigilance committee in the United States, later renamed the National Better Business bureau, with the purpose of forwarding higher standards of honesty and reliability in advertising. This committee organized, in connection with the various local clubs throughout the United States, local vigilance committees or Better Business bureaus to eliminate objectionable and untruthful advertising. The purpose of these bureaus has been to carry on locally in each city active efforts, similar to those of the national bureau, toward the elimination of dishonest and objectionable advertising and related business methods. Up to 1952, such bureaus had been established in 85 cities in the United States, including Boston, St. Louis, Cleveland, Indianapolis, Kansas City, Des Moines, Minneapolis, St. Paul, Spokane, Portland, Ore., and New York city. Six cities in Hawaii and Canada had also established bureaus.

An International Advertising conference was held in London in the summer of 1951, at which there was reaffirmed the principle of truth in advertising proclaimed at the first International Advertising conference held at Wembley, Eng., in 1924. The 1951 conference also resolved that advertising must be used increasingly to promote world trade and better international understanding, and that it must "seek its primary justification in service to the consumer by promoting knowledge, helping to reduce the costs of production and distribution, and helping to raise the standards of living."

**Facts About Circulations.**—In 1914 there was organized the Audit Bureau of Circulations. This became the leading agency for securing reliable information about the circulation and distribution of publications. The work of this bureau came about as the result of several organizations which were interested in the endeavour to develop a generally acceptable means of obtaining reliable, standardized statements of circulation. It was felt that the time was ripe for devising such means, and that the advertiser had a right to know what he was buying when he bought space in publications. It was desirable to know not only the total circulation but also something about the various aspects of this circulation, facts which are as important as the statement of the total amount of the circulation.

About 1870 the only facts generally available regarding circulation were the statements in George P. Rowell's *Directory;* and after that time the Ayer *Directory* was the chief source of information. In order to bring about a somewhat more reliable statement of circulations at that time, Rowell added a gold mark to the name of the publication if the publisher made an affidavit concerning his circulation. This was accompanied by an offer of $100 to anyone who could disprove the claim made. In general, the audit bureau reports attempt to answer three main questions:

(1) How large is the circulation? (2) Where does it go? and (3) How was it obtained? The bureau operates by requiring from its publisher members a so-called publisher's statement every six months. The bureau itself makes an audited report once a year.

The Audit Bureau of Circulations became of great value to advertising because it made available reliable statements of circulation covering many different phases. In case of error, either intentional or unintentional, the bureau established certain rules. A publisher or advertiser member of the bureau could ask for a reaudit of any publication, if he so desired. If the reaudit proved that the publisher had misrepresented the facts, the expense was to be borne by the publisher. This fact being then bulletined to the other members of the bureau, the publisher became subject to suspension and expulsion from the bureau. By Aug. 1951, 270 general magazines and periodicals, 72 farm publications, 370 business publications and 1,974 newspapers were members of the bureau. In addition to publications, 485 advertisers and 180 advertising agencies were members.

About 1913 there was organized in the United States the Association of National Advertisers, another important influence in the study and development of advertising practices. Likewise, during that period publishers developed a distinct consciousness of censorship of advertising. A considerable number of publishers took a definite stand with regard to the advertising which they would or would not accept. The announced or stated policy might not be fully lived up to in practice in all instances, but the best evidence of actual progress made in this regard lay in a comparison of mid-century issues of leading magazines and newspapers with issues of the early years of the century. The improvement was marked. In addition to the elimination of objectionable and doubtful advertising, a considerable number of media went a step further by guaranteeing their advertising in the sense that they would either themselves make good on any misrepresentation or deception which appeared in connection with an advertisement, or would see that the advertiser in question made good. With most of the high-grade media a policy of guaranteeing is substantially implied, and is almost unnecessary in view of the commendable care which is exercised in rejecting questionable commodities or irresponsible business houses.

In 1917 the American Association of Advertising Agencies was organized. It contributed materially toward the establishment of standards of practices and uniform methods of procedure. In 1925 it inaugurated a department of research for studying fundamental problems of advertising and marketing. Finally, and perhaps most important, an increasing use of research methods developed. Following World War II the association concentrated on four programs: development of better personnel for advertising; promotion of better research; advocacy of better ethics; and the support of better relations between the public and advertising.

## SUMMARY OF DEVELOPMENTS AFTER 1850

Considering the period from mid-19th to mid-20th centuries as a whole, the chief developments, in addition to those mentioned, may be designated as follows:

**Growth in Quantity.**—There was a tremendous growth in the number of firms employing advertising in one form or another. In 1951 there were about 14,000 firms doing some national advertising. A study by *Printers' Ink* in 1951 listed 222 advertisers spending more than $1,000,000 annually. There was likewise an enormous growth in the number of media. In 1830, it is estimated that there were approximately 800 magazines and newspapers in the United States, of which about 50 were daily publications. Their combined annual circulation was estimated at about 60,000,000 copies, or a circulation of approximately 950,000 copies per issue. In 1830 the total population of the United States was 23,500,000.

In 1861 there were 5,203 papers and magazines for a population of approximately 30,000,000. In 1950 there were 13,492 magazines and newspapers in the United States for a population of about 150,000,000. In other words, there had been an increase of magazines and newspapers since 1861 of approximately 2½ times, whereas the population during the same period of time had increased approximately 5 times; but since 1830 the population had increased more than 6 times, while the number of magazines and newspapers had increased almost 17 times. A more striking increase took place in the total combined circulation. The estimated combined circulation per issue of 270 magazines was (1951) 150,600,000 copies, and the total combined circulation of the newspapers approximately 114,230,000. Thus since 1830 there had been a growth in total combined circulation of all magazines and newspapers from less than 1,000,000 to approximately 265,000,000 per issue.

During that period, also, there developed entirely new media of advertising, including bus and car cards, posters, direct-mail, motion-pictures and radio and television advertising. Street-car advertising did not come into general use until about 1890, when the change was made from horse-drawn cars to electric cars. The mail-order field developed rapidly. Not only did mail-order houses spring up in large numbers during the period, but also business firms of all kinds developed a very extensive use of direct-mail material in the form of circulars, catalogues, letters and so on. The large mail-order houses commonly sent out twice a year more than 14,000,000 large catalogues, in addition to numerous smaller departmental catalogues issued. Figures obtained in 1951 estimated the total approximate amount spent in direct-mail advertising to be $878,754,000.

From the time that commercial radio started in the early 1920s it spread until at the beginning of 1952 there were 42,700,000 homes with radio sets. At the same time, there were about 105,700,000 receivers in use in the United States, a figure that included extra sets in homes, those in automobiles, hotels, bars, stores and institutions, and portable sets. Expenditures for time on the four major networks amounted to approximately $175,000,000 in 1951.

Television had an even more spectacular growth. Sets in use by the public on Jan. 1, 1952, were estimated at 14,500,000, compared with 10,000,000 at the beginning of 1951; 3,950,000 in 1950; 1,000,000 in 1949; 189,000 in 1948, and 16,476 in 1947. From a few television stations on the air in 1947 the number had risen to 108 by the start of 1952. Time charges on the four major television networks were estimated at $125,000,000 for 1951.

**Advance in Quality and Scope.**—During the period under consideration there was a distinct improvement in the quality of advertising. Methods of printing, typography, colour printing, art work and the like greatly advanced. Besides the mechanical improvements there were distinct advances in such essential qualities as accuracy of statement and descriptions, reliability and truthfulness. A widening of the scope of advertising developed rapidly. There was a marked increase in the variety of advertising used. Perhaps the dominating types of advertising which flourished originally—that is, about the middle and latter half of the 19th century—were patent-medicine advertising and circus bills and in general much unreliable, dishonest and objectionable advertising. As developed there is hardly a business or type of commodity for which the printed word is not used as a means of selling. Banks and financial institutions of high grade turned to advertising, finding it profitable to employ in a dependable manner the methods which had been found profitable by unreliable financial houses. Advertising suffered because of the objectionable features which were so prominent in its earlier development. For this reason, undoubtedly, high-grade financial houses and to some extent other types of business were slow to take advantage of the possibilities which it offered, but later they adopted the modern techniques of general advertising.

Public service institutions use advertising to place themselves before the public, to secure the co-operation of the community, and to offer their securities to customers and to others. What is termed institutional or good-will advertising is widely used, not only by banking or similar institutions, but by large firms of all kinds, retail stores and manufacturers. Causes of one kind or another—local, national and international—use advertising to secure publicity and to gain adherents. Churches, charitable institutions, schools, educational endowments, public health bureaus, political parties, candidates and even governments find advertis-

ing a suitable and dignified means of publicity. In industrial disputes, employers and employees alike use advertising to influence public opinion and secure sympathy and moral support.

The development of trade-marks was likewise a conspicuous characteristic of the periods mentioned, particularly of the first half of the 20th century. A large proportion of the trade-marks known throughout the United States and all over the world developed during this time. The development of national and international business made trade-marks virtually a necessity; and advertising became an important means, perhaps the chief means, of making them known to the public. The Lanham Trade-mark act of July 5, 1946, effective in July 1947, established important new principles in the federal legal protection of trade-marks.

**Volume of Advertising.**—Some notion of the immense proportions of advertising may be gained from the amount of money expended and from the amount of space and time used each year for advertising in the United States. It was estimated that in the neighbourhood of $6,500,000,000 was being spent annually for this purpose at mid-20th century. Approximately $1,000,000 was spent annually for advertising any one of a score or more of well-known commodities, as high as $5,000,000 and $8,000,000 being spent in some cases. Or we may gain a concrete idea of the immensity of advertising from the cost of space for single advertisements in some of the leading media. Thus, for example, a page in a well-known monthly magazine in a single issue may cost $18,500 and the back outside cover about $24,000. A page in a well-known weekly publication would run to $18,800, and the back outside cover $24,300. A page in the large metropolitan newspapers costs as high as $4,200. From still another angle the immensity of advertising is indicated by the fact that approximately three-fourths of the cost of maintaining a newspaper or a magazine comes from its advertising space.

The outsider naturally wonders whether advertising with such high rates for space can really be a profitable aid in selling; or whether it may not be an expensive luxury indulged in by large business concerns. The extent to which advertising plays a justifiable role in the distribution of goods is an important and intricate problem which must be dealt with in any important consideration of the subject.

## ARGUMENTS FOR AND AGAINST ADVERTISING

There are wastes in advertising, but there are wastes everywhere in production, in distribution, in personal selling. Economy in the distribution side of business has lagged behind, but distinct advances have been made. Probably the chief sources of waste in advertising are:

(1) The lack of proper co-ordination between advertising and the other phases of a business—lack of co-ordination with distribution, personal sales, plans and production—advertising where there is no distribution, and the like.

(2) The use of inefficient methods—weak, unconvincing and ineffective appeals, poor presentation, ineffective technique, the use of too large space or too small space as the result of guessing instead of finding the facts on which to build and plan. It has been estimated that if every advertising message were made 10% more effective it would mean a saving of $500,000,000 to the business interests of the United States.

(3) The use of advertising for commodities in circumstances in which returns are highly uncertain, or for business ventures which are too hazardous.

(4) The excessive use of advertising in over-keen competition.

(5) The failure to make all advertising literally truthful and dependable. Even if 96% or 97% of advertising were in the main trustworthy and meritorious, the remaining 3% or 4% would weaken the effectiveness of the rest.

(6) The use of advertising for illegitimate business, highly speculative investments, financial frauds or for commodities of doubtful value or actually injurious to mankind.

Improvements are proceeding in all these directions. Fundamentally, these sources of waste are not peculiar to advertising, but are due to the waste and inefficiency in business as a whole. The same sources of waste exist in oral selling—making plans on guesses instead of on facts, not being literally truthful and dependable in every instance, a lack of proper co-ordination with other phases of a business, the waste of time on the part of salesmen, and excessive personal expenditure. Preliminary time studies show that the average salesman uses only about 15% to 50% of his working time in actual selling. Fundamentally these wastes in oral as well as in printed selling are not to be laid upon these two aspects of business, but are due to conditions in business as a whole, to mistaken judgment, to ignorance and moral weakness.

**The Case Against Advertising.**—The actual total amount of money spent on advertising is large. The estimated amount spent in the United States in 1951, for example, was approximately $6,500,000,000.

The questions are: (1) Who pays for it? (2) How far different would be the price of commodities if this expenditure were entirely eliminated? and (3) In what way would the methods of distribution and the cost of distribution be different? The critic assumes that this money is an economic waste and that prices are higher because of it

A second argument is that advertising considerably increased the demand for, and the purchase of, luxuries and semiluxuries such as cameras, beverages, automobiles, radio and television sets, vacuum cleaners and so on.

A third argument is that advertising was responsible to a considerable extent for the increasing and widespread use of packages, cartons, wrappers and labels for a large variety of products. Advertising was responsible to a very large extent for the development of standardized brands and trade-marked articles These wrappers and containers cost money which supposedly is not a part of the price paid for commodities bought in bulk. The argument is that all of this expenditure is added to the price of the product.

**Relative Cost.**—It is found that the amount actually spent for advertising specific commodities differs widely from the amount which the average person thinks is spent. Almost every person who makes a general statement that the prices of commodities are higher because of the advertising, or that the money expended for advertising is wasted, knows little about the actual facts of the relative amount of money expended for advertising a specific commodity. People quite generally have a greatly exaggerated notion of the amount of money spent for printed advertising. An investigation was made to determine the amount which people think is spent for advertising certain commodities. The results of the investigation showed that people generally overestimate from four to five times the amount spent for advertising specific products. For example, the amount spent for advertising a package of a leading food retailing at ten cents was estimated by this representative group of persons as two cents, whereas the actual amount spent by the manufacturer of this food for advertising a single package was three-tenths of a cent, an overestimation of about eight times.

Averages of expenditures for advertising by 119 member companies of the Association of National Advertisers were studied in both 1939 and 1951. The reported advertising expenditures in all industries represented increased substantially between these years, but the increase in sales during the same period was substantially greater. In most cases the proportion of advertising expenditures to sales was small, although in the drugs and cosmetics industry it is traditionally large.

TABLE I.—*Advertising Expenditures as Percentages of Sales*

| Industry classification | 1939 | 1951 |
|---|---|---|
| Agricultural equipment | 2.6 | 0.9 |
| Alcoholic beverages | 6.1 | 5.2 |
| Automotive | 3.4 | 1.4 |
| Building materials | 1.7 | 1.4 |
| Drugs and cosmetics | 28.0 | 28.0 |
| Electrical appliances | 3.0 | 4.7 |
| Food and groceries | 5.0 | 4.3 |
| Home furnishings | 2.9 | 3.8 |
| Industrial | 1.3 | 0.9 |
| Insurance | 0.3 | 0.2 |
| Office equipment | 2.1 | 2.4 |
| Paper manufacturers | 0.9 | 0.8 |
| Petroleum | 1.8 | 1.0 |
| Textiles and clothing | 4.2 | 3.3 |
| Other industries | 4.8 | 5.0 |

Source: Association of National Advertisers

The average expenditure for advertising on the part of retailers at mid-20th century was probably less than 3%. Figures showing the average ratio of advertising to sales in small and medium-sized stores for various years between 1943 and 1950 were published by Dun & Bradstreet, Inc., who pointed out that these percentages should not be considered an exact reflection of advertising costs, because of the wide variance among retailers in defining advertising and advertising costs. It is therefore evident

TABLE II.—*Average Ratio of Advertising to Sales for Small and Medium-Sized Retailers*

| Type of store | Percentage |
|---|---|
| Appliance-radio-television dealers | 2 8 |
| Auto accessory and parts stores | 1 2 |
| [illegible] | 1.0 |
| Bakeries (retail) | 1.1 |
| Book stores | 1.6 |
| Camera and photographic supply stores | 1 9 |
| Department stores | 1 8 |
| Drug stores | 0 6 |
| Dry goods and general merchandise stores | 0 8 |
| Farm equipment dealers | 0 7 |
| Furniture stores | 1 9 |
| Hardware stores | 1 1 |
| Meat markets | 0 2 |
| Jewelry stores | 3 6 |
| Liquor stores (package) | 0 3 |
| Men's clothing stores | 3 3 |
| Men's furnishings stores | 0 6 |
| Paint [illegible] stores | 1 8 |
| Sporting goods stores | 2 0 |
| Stationers (commercial) | 1.3 |
| Tire dealers | 1 4 |
| Variety stores | 0 7 |
| Women's accessory and specialty stores | 1.0 |
| Women's ready-to-wear stores | 3 0 |

Source: Dun & Bradstreet, Inc.

that while the total expenditure for advertising runs into large figures, the relative expenditure in proportion to the cost of a commodity is small. In other words, if advertising played no part whatever in stimulating the sale of commodities, and if the cost of advertising were therefore directly added to the price of a commodity to the consumer, the price of an article would be almost inappreciably higher. An article selling at $1 00 would have to be sold at $1.04 or $1.05 if advertising were purely a dead expenditure of money. Although the actual expenditure for advertising is relatively small—probably not more than 4% to 5% in the aggregate—even this expenditure would be a serious waste if it produced no economic or social value. The 1% to 3% spent by retailers, or the 2% to 3% spent by manufacturers, would in many instances serve to make the difference between success and failure.

**Effects of Advertising.**—In 1925 a National Distribution conference was held in Washington, D.C., under the auspices of the Chamber of Commerce of the United States. The report of the committee appointed to investigate "Market Analysis—Advertising and Advertising Mediums" gives some information with regard to the point just brought up. The investigation consisted of a survey of articles which had appeared in publications, giving specific data about the effects of advertising on costs and prices to the ultimate consumer; and in addition of a questionnaire which was sent out to a group of national advertisers, requesting specific data showing the effects of their advertising on their costs and prices. The results were tabulated and summarized in part as follows:

From the data available it is hardly possible to make a non-disputative demonstration. Nevertheless, we believe that it can safely be said that the use of effective advertising by national distributors as a general rule produces one or more of the following results:—

(1) Decreases the cost of selling.

(2) Lowers the cost of production on account of increased volume.

(3) Lowers prices to the consumer and thereby raises the standard of living.

(4) As a by-product, aids in the education of the general public.

Data have been obtained from a number of national advertisers to show the effects advertising has had upon the cost of production and the cost of selling, and prices to the consumer. It is realized that changes in business conditions during the past few years and changes in distribution policies within the individual companies make it very difficult to eliminate the variable factors and to prove the effects of advertising. The data which have been collected, however, seemed to indicate conclusively that the first three results named above are brought about by advertising.

In addition to the four results obtained by advertising which have been mentioned above, advertising often has the following beneficial effects for the manufacturer, dealer or consumer.—

(1) Advertising aids in stabilizing production

(2) Advertising aids in [illegible] and quality.

(3) Advertising aids in the simplification of products. (Elimination of unnecessary items in the line)

(4) Advertising helps to prevent fluctuation in prices.

Advertising's outstanding contribution consists of its part in promoting a dynamic, expanding economy, it was concluded by Neil H Borden, professor of advertising in the Harvard Graduate School of Business Administration, in an exhaustive study of *The Economic Effects of Advertising* published in 1942. He said that from a social standpoint advertising's chief task was to encourage the development of new products, and that from the resulting enterprises had come a flow of income that raised the level of material welfare to a point never before known He maintained that since advertising had been largely associated with the promotion of new and differentiated merchandise, a substantial part of advertising costs should be regarded as growth costs incurred in raising the economy from one level to another.

**Summary of Advantages.**—A beneficial effect of advertising has been the reduction of seasonal fluctuation in the volume of business. In certain fields of business, the seasonal fluctuation, if not entirely eliminated, was greatly reduced. The two seasons of buying men's clothing were greatly extended, and the sale of toys, formerly largely confined to the holiday season, became more evenly distributed throughout the entire year. The same was true of fountain pens, millinery, oranges and lemons and other products The result was a reduction in the cost of doing business.

Advertising also aided materially in the standardization of products and quality of goods. This was brought about through the establishment of brand names and trade-marks, which became associated with uniform quantities and qualities in the mind of the public, until the recollection of a brand name of any number of specific products calls up the picture of a certain definite quantity and a certain recognized standard of quality, which the public has been educated to receive when it calls for a product by a specific trade name. Although the establishment of standard packages probably added to the cost of commodities to some extent, it had certain other advantages. It facilitated retailing, requiring less time on the part of assistants in the preparation of products for delivery to the consumer, and it secured a more hygienic handling of goods, particularly foods

The noteworthy advances made in the general level of living, in public taste, in personal and domestic conveniences, and in the general use of cultural agencies, must be attributed in part to the use of the printed word in the form of advertising. Such products as automobiles, radios, vacuum cleaners, better-fitting clothes, better-constructed and designed houses, better-painted houses, evidence the advance made in the level of living, largely as a result of the insistent and continuous force of advertising. There is no doubt that we should very likely have most if not all of these improvements and conveniences without advertising, but probably not so many people would have had them so soon. Printed publicity and radio and television no doubt helped to educate people to want more and better things in food, clothing, housing, personal comfort and enjoyment.

The almost universal reading of magazines and newspapers was made possible largely, if not solely, through advertising, since more than three-fourths of the income of a periodical is ordinarily derived from its advertising space. In this sense, the newspaper or magazine is practically a by-product of advertising. The comparatively small sum charged for a newspaper or magazine —in comparison with the large sum which such magazine or newspaper would cost if it were not for the advertising which it carries —made some form of reading matter available to even the poorest classes of people. Advertising revenue made possible the large-scale production of newspapers, magazines and periodicals of all kinds, the social and educational value of which is beyond esti-

mate. The whole cost of radio and television programs is paid for by advertisers.

It seems to have been found from experience that some products may be sold most economically primarily through personal salesmanship, that some products may be sold to certain classes of people most economically primarily through printed salesmanship, but that probably the great majority of products may be distributed most economically by varied proportions of personal and printed selling and the judicious use of radio's spoken word and television's mass demonstrations. So long as competition is believed to be a desirable factor in human welfare, just so long will competitive means be used. Critics of advertising perhaps may neglect the fact that if advertising were eliminated or abolished, other competitive methods would necessarily be substituted for it. If the use of advertising were eliminated, it is quite likely that its place would be taken in most instances by some form of personal selling, with its accompanying expense. The fact that numerous firms which consistently and continuously used advertising over a long period of years survived from early periods of business activity may be taken as some indication that advertising has been found to be a fairly effective agency of business progress.

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## GREAT BRITAIN

Advertising's principal function is to assist in the sale of goods and services and, particularly where it is employed by the state, in the inculcation of ideas. To this end, according to the *Statistical Review of Press Advertising,* about £36,913,899 was spent on the purchase of displayed advertising space in Britain's newspapers, magazines and trade publications in 1950; of the total it is estimated that government advertising alone accounted for £1,209,496. These figures took no account of the cost of filling the columns thus acquired. The Select Committee on Estimates in its 1950 report noted that, in the years 1948–51, an average of £15,000,000 annually was expended on the government information services, covering all forms of official advertising, publicity and promotion through such diverse agencies as the central office of information, the foreign office and the British council.

On the basis of test and experience it is possible to forecast what a particular promotional effort is likely to yield in terms of sales. Market research methods employed by advertising men also enable a manufacturer to estimate the limits of his market, so that he may plan his factory's production. The A. C. Nielson method of retail shop auditing provides manufacturers with information about the movement of their own and competitors' goods from the shops. Where in any specific field of manufacture public preference is seen to be moving in the direction of certain brands, rival manufacturers can adjust their advertising, their packaging or the characteristics of their products accordingly. Over an extensive range of consumer goods (notably packaged foods, drugs and toilet products) sales are continually affected by the fickleness of public taste.

The case for advertising by the state rests on different grounds. If it is to intervene regularly in the day-to-day lives of adult citizens in a democracy, a government must employ all the methods of mass communication available to it to secure their co-operation. This is the argument used to justify large-scale advertising by the state to encourage saving, to persuade parents to have their children immunized against diphtheria, to promote road safety and fuel economy, and so on. There have also been drives, aided by modern publicity, to secure recruits for the armed services and for the police and, through the ministry of food, to explain how to make the best use of rationed foodstuffs. Moreover, the nationalized airways, railways and gas and electricity boards in Great Britain continue the use of advertising for selling and informative purposes started under private ownership. Although the need for advertising by monopolies such as the post office is sometimes questioned it is argued that a monopoly no less than a private organization must create confidence among its clients. The pioneer work of the London Passenger Transport board has been widely commended in this connection Although there had earlier been a limited amount of "official" advertising, notably on behalf of the post office, the British Industries fair and the old Empire Marketing board, it was World War II that provided the greatest impetus for the large-scale use of advertising for government ends.

As a result of the nationalization of Britain's transport after World War II the state became actively interested in the disposal by hire of advertising sites on railway property, inside railway coaches and in and on buses and trams. In 1949 the British Transport commission's net receipts from the sale of advertising space amounted to £2,207,610, its biggest single source on "noncarrying" revenue.

**Agencies and Managers.**—The bulk of the commercial advertising in Britain is placed by specialist firms of advertising agents, who are appointed by advertisers to handle their accounts. Normally no fee is paid by the advertiser for this work, the agent receiving a commission (varying from 10% to 15%) on the cost of the advertising from the newspaper or magazine with which it is placed. In practice agencies charge the client directly for special work, and frequently an extra "service fee" of about 2½% is imposed. The service of a first-class advertising agency to its clients includes direct examination of markets and elaborate research; the designing of packages and wrappings for new articles; the invention of selling plans; the formulation of an advertising policy and its embodiment in press advertisements, posters and other forms of advertising; the preparation of window-dressing designs and materials and of showcards; and contracting with newspapers, periodicals and hoarding-owners for the supply of space. The bulk of the agencies are members of the Institute of Incorporated Practitioners in Advertising, which enforces standards of practice designed to eliminate such unprofessional conduct as the active solicitation of other agencies' accounts.

The agency system enables the owners of advertising media to do business conveniently with thousands of advertisers through about 500 offices centred in the big cities. Also, the agent in his own interests must encourage businesses that may not have used advertising to discover how it can be of value to them. The advertiser likewise gains because, through the agency, he has a call on the services of expert teams whom he could not afford to employ on his own staff.

Nevertheless many bigger advertisers and those operating in technical and specialist fields do run advertising departments of their own which, while working in co-operation with the appointed agents, frequently carry out the bulk of the planning and creative work. The large advertising department is the exception rather than the rule, but regular advertisers nearly always appoint one executive, sometimes a director, known as the advertising manager to act as a liaison between the board and the agency. The Incorporated Advertising Managers' association, to which the leading managers belong, works to secure full recognition of its members' importance.

**Media.**—There are six main methods by which the advertising message can be delivered to the public in Great Britain. These are: the press, which includes newspapers and magazines of all kinds; outdoor advertising, which includes hoardings, *solus* sites, advertising on transport systems, and electric signs; direct mail, which is the professional term for advertising material addressed individually and sent through the post; exhibitions and displays; films and slides in cinemas, theatres and elsewhere; and radio. (In 1951 there was no advertising on the British television service which is controlled by the British Broadcasting corporation. Agitation to secure facilities for advertising programs was being conducted both in parliament and outside.)

Of these the most important is the press. The *Statistical Review of Press Advertising* gives the following figures for the value of space bought in the various departments of newspaper and magazine publishing during 1950: London mornings £10,516,697, London evenings £2,480,810, national Sundays £4,350,572, pro-

vincial dailies £4,810.829, provincial and suburban weeklies £1.417,614, magazines £10,887,276, technical £1,038,719 and trade £1,357,382. In 1950 more than 50 British advertisers spent £75,000 or more apiece on press advertising alone. In some cases individual sums were more than £200,000. for example, Oxydol £299,000, British Railways £240,000, British Electricity authority £225,000, Dreft £213,000 and Wisk Detergent £201,000.

Although the London morning newspapers, sometimes called the "national" dailies, have long been recognized as the major mediums for advertising in Great Britain, they lost something of their pre-eminence after World War II through the vastly extended influence of the mass circulation magazines In the first place the paper or "newsprint" available to newspapers was more severely rationed than was that supplied to magazine publishers; in the second, the exploitation of new printing techniques, especially colour, enabled the magazines to improve their standing with the public. Whereas it had only 17.18% in 1935, the general magazine press had 34 59% of the annual advertising expenditure recorded for 180 different sorts of product in 1949. In the same period the London mornings' share declined from 36.52% to 23.86%.

It has been alleged that, because of their vast expenditure in the press, advertisers exert an influence on editorial policy. However, the report of the Royal Commission on the Press which sat between 1947 and 1949 stated that although individual advertisers occasionally sought to influence newspaper policy or to obtain the omission or insertion of particular news, such attempts appeared to be infrequent and unsuccessful. The same report pointed out that as long as newspapers were sold for less than what they cost to produce they would need a supplementary income and that the sale of their space to advertisers appeared to be one of the least harmful of the possible sources, but that the publication of advertisements was in any case an essential part of the service which newspapers rendered to the community.

The majority of publishers belong to the Audit Bureau of Circulations, which makes available authenticated half-yearly records of individual newspaper and magazine sales. Some publishers issue their own audited certificates. After World War II considerable attention was paid to "readership." Circulation is a vague term, and one purchased copy of a paper may have several readers. The annual *Hulton Readership Survey* charts the extent to which various newspapers and magazines are seen by other readers than the purchaser of each copy. Hulton's study of "advertisement attention values" was an attempt to show what proportion of the readers of a particular publication read the average advertisements therein.

Outdoor advertising is less amenable to analysis, but valuable work was published by Mills and Rockley's, a big firm of British provincial outdoor advertising contractors, and by the London Transport executive. The latter, in *London's Travelling Public* (1950) gave details of the age-composition and the income levels of those whom advertisements on their properties were likely to reach.

More than any other form of publicity, outdoor advertising has been criticized by the general public and in official quarters. Many charges of disfigurement were undoubtedly true in the past; however, as a result of the enlightenment of owners of regular hoardings and sites and, from 1949, the operations of the Town and Country Planning act, such complaints became considerably less valid. Furthermore, town planning authorities have admitted that outdoor advertising has a legitimate commercial function to perform and can be incorporated within planning programs to the advantage of the community. The way in which the modern, soundly constructed hoarding can even make a contribution to local planning arrangements, was demonstrated in the neighbourhood of the South Bank exhibition during the Festival of Britain (1951): a number of unsightly views exposed by rerouting of roads and other reconstruction work around the site were hidden by judiciously placed advertisement hoardings, in some cases set amid miniature gardens and floodlit.

Whereas advertisements in the press are frequently designed to present long and persuasive arguments on the advertisers' behalf, outdoor media, whether posters or signs, are for the most part used to drive home what advertisers call "reminder messages" These consist of the name of the product or service being advertised together with a brief and telling slogan Nicholas Kaldor and Rodney Silverman in *A Statistical Analysis of Advertising Expenditure and of the Revenue of the Press* (1948) estimated that in 1935 approximately £6,500,000 was spent on outdoor publicity.

The poster, by reason of its size and the facilities which it affords for the use of colour, has a powerful effect on the public mind. Announcements can be displayed before more people for a longer time by means of a poster than by the same expenditure of money in the press If, however, more is desired than an instantaneous impression on the mind, the advertising value of the poster falls sharply

Large painted signs on gable ends; sky signs on the roofs of houses; a variety of illuminated signs; mobile devices for shop windows; posters on buses, trams and carriers' vans; the rather antiquated expedient of sandwich-sign men; and motor delivery-vans modelled on the shape of the owner's specialty, enormously magnified, are among other forms of outdoor publicity

A development which, following World War II, added to the attention value of posters of all kinds was the introduction of luminous inks. In electric signs, the continued extension of the neon principle resulted in the remarkable nighttime advertising effects which are such a feature of the entertainment and shopping centres of Britain's big cities, particularly at Piccadilly Circus in London. Equal progress was made in the production of smaller electrical units for use in local shop windows and on counters.

An increasingly popular method of marketing is to advertise for direct orders from the public through the post, and a feature of the popular national newspapers is the space, sometimes as much as a full page, given over to what are called "bargain squares" A typical collection of "bargain squares" will carry offers of clothing and household goods, all of which can be obtained either on the cash-on-delivery principle or by forwarding a cash or postal order for the stated amount to the advertiser, when the line requested will be dispatched to the customer by post. Because this form of trading would lend itself to sharp practice if not strictly supervised, newspapers are at pains to ensure that only reputable dealers are permitted to ply their trade in the paid-for columns.

A variant of the "mail-order" system described above is the unsolicited approach through the post, known as "direct mail." Certain classes of advertising agents specialize in direct mail and devote considerable attention to the compilation of selective mailing lists. In this way an advertiser who wishes to reach certain small groups of people can forward advertising matter direct to any special group, *e.g.*, clergymen, chemists, etc.

Advertising by means of exhibitions and displays called into being a whole range of specialist artists and craftsmen whose talents may be seen at such events as the Motor show and the Radio exhibition or in the windows of the local store. What is known as "point of sale advertising," comprising the window bills, cut-outs, display cards and other forms of promotion supplied by the advertiser to the retailer, may also be included under this heading. The British Display association, representing individuals occupied in the craft of display, and the Display Producers' and Screen Printers' association, representing the majority of the firms engaged in the production of display material, are the moving professional bodies behind this section of the industry.

The possibilities of the newly discovered "magic lantern" as a medium for advertising were recognized at the end of the 19th century when slides were first shown on screens in theatres and music halls. The introduction of the cinematograph led to the production of short moving-pictures, incorporating an advertising message, displayed during the intervals of regular entertainment programs. After the arrival of the sound film this process was further accelerated, and with the increasing use of the portable 16-mm. projector the production of lengthy specialized instructional and documentary films for showing to selected audiences at clubs, canteens and women's institutes—the so-called "non-theatrical" screening—became a favourite weapon in the advertiser's armoury.

At mid-20th century there were approximately 4,800 cinemas in the United Kingdom, with a total seating-capacity of 4,200,000; on an average each seat was being used seven times a week. Of these 4,800 cinemas about 4,300, with a seating-capacity of 3,500,000, were prepared to show advertising films To speak broadly, there are only two types of advertising films shown on British cinema screens. the individual two-minute film and those which run for 12-18 sec. together with others of the same length. For his share in the latter type of production the advertiser might pay approximately £2,500 and for this would be guaranteed 26 weeks' showing in 100 cinemas.

Advertising by means of radio or television—that is, commercial or sponsored broadcasting—has been the subject of severe limitations in Great Britain because of the setup of the broadcasting arrangements These preclude both the use of the British Broadcasting corporation's transmitters for the purpose and the establishment of rival broadcasting stations on British soil In these circumstances before World War II a considerable business had grown up in the use of private broadcasting stations in France, which devoted much of their program time to the transmission of whole sessions recorded in London at British advertisers' expense and intended for listeners in Britain. But all such activity ceased after 1939, and after World War II France abandoned its system of joint state and private enterprise in broadcasting in favour of an official monopoly like the B.B.C's. Radio Luxembourg, however, in the grand duchy of Luxembourg, had also carried British sponsored programs up to 1939 and reverted to this system at the end of hostilities: a powerful new transmitter, beamed on Britain, was opened up in 1951 and began to radiate popular entertainment programs interspersed with advertisers' messages for six hours every night. In Nov. 1951 it was calculated that about 15% of the adult population of the United Kingdom were regularly hearing Luxembourg's broadcasts in [illegible] Broadcasting committee headed by Lord Beveridge, in its report on the future of British radio and television issued in 1951, recommended against the introduction of the sponsoring system in Britain, although Lord Beveridge himself and one other member of the committee thought that there would be no objection to allowing it provided that it was subject to suitable controls.

Usually classified under advertising is the type of activity variously known as press or public relations. In its simpler, earlier form this was undertaken by so-called press agents, generally employed on behalf of entertainment interests, who by means of prearranged stunts sought to get inserted into the non-advertising columns of the press stories and pictures of the activities of film and stage performers—an operation calculated to develop their box-office value. Exploitation of the individual in this fashion continued to go on, but commercial firms, professional organizations and governments also came to use the press, the cinema and the radio to present their views and activities to the world. A public relations officer working for a firm of motor-car manufacturers sees that newspaper motoring correspondents have every facility for reporting on the firm's new models. Similarly the British foreign office through its own press department arranges ministers' press conferences. There is an Institute of Public Relations to which the higher public relations officers belong.

As well as helping to sell goods *en masse* to the consuming public, advertising performs certain less obvious but no less valuable functions Thus there is a considerable amount of "internal" advertising undertaken by manufacturers and aimed at others in the business, generally the retailers and wholesalers. Examples are to be seen in the extensive trade and specialised press, which serves every section of industry, every occupation and every profession. This advertising is often an important adjunct to the consumer campaign: in creating sales among the public a manufacturer must win the favour of those who are to pass his product "over the counter" to the ultimate buyer.

**Organization.**—The central professional body of the advertising industry in Great Britain is the Advertising association. It groups together all the interests—advertisers, advertising agencies and media owners. The majority of the other specialist organizations, such as the Institute of Incorporated Practitioners in Advertising and the Incorporated Advertising Managers' association are affiliated to the Advertising association and thus have a common meeting ground on which to discuss problems. Among the association's objectives are the promotion of public confidence in advertising and advertised goods through the correction or suppression of abuses which undermine that confidence; encouragement of the study of the theory and practice of advertising and the improvement of its technique by the institution of courses of study, holding of examinations and the awarding of diplomas; establishment of the fact that efficient advertising is an essential factor in the marketing of produce and manufactured goods and in the economic life of the country; demonstration of the efficiency of the service that advertising and its associated interests can give to industry and the public; and furtherance of the adoption of standards of practice in the business relations between publishers, agents and advertisers.

One of the most important aspects of the Advertising association's work is to be found in its Advertisement Investigation department, which undertakes to check abuses in the wording and presentation of advertisements. The department regularly issues to the association's members reports on advertising which it considers to be undesirable, and in this way a great many appeals to public cupidity, seemingly innocent to the unpracticed eye but thoroughly disreputable in intent, have been refused admission to the advertisement columns of the serious press.

One instrument whereby the advertising business seeks to keep its house in order is the *British Code of Standards in Relation to the Advertising of Medicine and Treatments,* which has the support of the following organizations: the Newspaper Proprietors Association, Ltd., the Newspaper society, the Periodical Proprietors Association, Ltd., the Proprietary Association of Great Britain, the Advertising association, the Incorporated Society of British Advertisers, Ltd. and the Institute of Incorporated Practitioners in Advertising. The code declares that no advertisement should contain a claim to cure any ailment or symptoms of ill-health and that no advertisement should contain a word or expression used in such form or context as to mean, in the positive sense, the extirpation of any ailment, illness or disease. Treatments or medicines for illnesses which properly require medical attention, misleading or exaggerated claims, appeals to fear, diagnosis or treatment by correspondence, and "money back" offers are all dealt with in the code's recommendations. More specifically the code emphasizes that no advertisement should refer to any medicine, product, appliance or advice in terms calculated to lead to its use for the treatment of a number of specially enumerated illnesses or conditions These "illnesses or conditions" range from alopecia to varicose veins and include many familiar "conditions" such as baldness, arthritis and obesity. There are nine other codes operated by specialist sections of advertising, including the *Code of Standards* subscribed to by members of the Association of Specialized Film Producers (the trade body of the advertising and documentary film makers) the *Code of Standards of Advertising Practice* of the International Chamber of Commerce and the *Standards of Practice* of the Market Research society. A censorship committee of the British Poster Advertising association and the Solus Outdoor Advertising association—two associations of owners of outdoor advertising sites—is powerful enough to suppress any poster calculated to offend public taste or morality.

Representing exclusively the interests of advertisers as such is the Incorporated Society of British Advertisers, Ltd. which, while not affiliated to the Advertising association, frequently co-operates with it on matters of common concern. The I.S.B.A., founded in 1900, is the oldest body of advertisers (as opposed to publishers) and defends the interest of advertisers when they conflict with those of the agencies and the media owners. The I.S.B.A. works to ensure, among other things, that advertisement charges are not pushed up to uneconomical levels. It was the I.S.B.A. that in 1931 secured the establishment of the Audit Bureau of Circulations.

Indicative of the tendency for advertising to assume professional status is the growing reliance placed on examination in the

selection and promotion of staff. Two sets of examinations are conducted: a broad-based paper set by the Advertising association; and a paper concentrating more on agency practice set by the Institute of Incorporated Practitioners in Advertising. Facilities for study are provided by various commercial colleges and also through some of the 32 local advertising and publicity clubs affiliated to the Advertising association. These clubs, in addition to their social activities, arrange talks and debates on advertising subjects and seek to stimulate a sense of co-operation and unity among advertising people of the same neighbourhood. They are autonomous, but most of them send two delegates to the quarterly meetings of the Advertising association's Club Development committee.

**Advertisements in English Law.**—Apart from the provisions for formal notification by advertisement in the *London Gazette* and local papers of a large variety of matters of which the public should be informed, acts of parliament relating to advertisements have generally been restrictive. Nevertheless the principle of the spending of public moneys by government departments, local authorities and public corporations finds widespread acceptance.

Legislation affecting advertising is of two types: (1) that which protects the amenities of the countryside and certain urban areas; and (2) that which protects the public from excessive claims in advertisements.

In the first group the most important piece of legislation is the Control of Advertisements regulations, 1948, made under the authority of the Town and Country Planning act, 1947. Legislation in this field, however, began with the Advertisements Regulations act, 1907, which authorized bylaws by local authorities for the regulation and control of hoardings more than 12 ft. in height and for regulating, restricting or preventing the exhibition of advertisements calculated to affect injuriously the amenities of a public park or pleasure promenade or to disfigure the natural beauty of a landscape. In 1925 the powers were extended to include advertisements that would disfigure or injuriously affect the view of rural scenery from a highway or railway or from any public place or water, or the amenities of any village or of any historic public building or monument, or any place frequented by the public chiefly on account of its beauty or historic interest. The home office prepared model forms of bylaws, and by mid-century more than 100 local authorities in Great Britain had exercised their statutory powers.

Subsequently a series of provisions under various town and country planning acts developed further control of outdoor advertising. Then the Town and Country Planning act, 1947, gave the local authorities full control over all outdoor advertising, except minor groups of it, within their territories. In the special areas that appear to the minister to require special protection on grounds of amenity (*e.g.*, rural), express consent from the local planning authority normally has to be obtained before an advertisement site can be located or constructed; but in certain cases—for instance for advertisements on business premises or for functional advertisements by the other local authorities—consent is deemed, that is, not required express. Such advertisements, however, are strictly regulated, both in special areas and in nonspecial areas, and the local planning authority has the right to challenge them. For instance, advertisements on business premises must relate to the business carried on and to the person carrying it on, including advertisements of the goods sold or the services rendered on the premises. In a special area they must not contain letters or figures exceeding 1 ft. in height and may not be more than 12 ft. above ground level. In nonspecial areas they must not be more than 2 ft. 6 in. in height, or more than 15 ft. above ground level.

A further important provision in the regulations is that outdoor advertisements cannot be displayed without the consent of the owner of the land or building on which it is being displayed. This provision has almost stopped "fly-posting," *i.e.*, posting without consideration of the amenities.

In congested areas further restrictions are often imposed for the greater safety or convenience of those using the streets. Thus, under the London Traffic act, 1924, the minister of transport may within the London traffic area restrict the use of sandwich-sign men and other persons in the street for the purpose of advertisement if they are likely to be a source of danger or to cause obstruction to traffic; and in 1927 the minister, Col. Wilfrid Ashley, forbade the use of displayed vehicles for advertising purposes in certain streets Within the City of London and the metropolitan police district no person may carry on foot or horseback or any carriage in any thoroughfare or public place any advertisement to the obstruction or annoyance of the inhabitants or passengers (London Hackney Carriage act, 1853); and by the Metropolitan Streets acts, 1867 and 1885, no advertisement, except in such form and manner as may be approved by the commissioner of police having jurisdiction in the area, may, within six miles of Charing cross, be exhibited or distributed in any street by any person on foot or riding in any vehicle or on horseback. In the County of London, by the London Building act, 1894, and in areas in which the Public Health Acts Amendment act, 1907, applies, sky signs as defined by those acts are prohibited. By a bylaw made in 1900 under general statutory powers for the suppression of nuisances, the London County council, in great measure as a result of observation made at coroners' inquests, prohibited advertisement by searchlight or flashlight causing danger to traffic in any street "Flashlight" is defined as a light which alters suddenly either in intensity, colour or direction. A large number of bylaws for the regulation of advertisements have been passed in different parts of Great Britain.

Other advertisements are prohibited by statute because they are themselves an evil or because they are incidental to evils which the legislature wishes to suppress. Although moneylending is a legitimate trade, it tends to create abuses unless it is severely restricted. In 1892 the sending of an advertisement to any person under legal age inviting him to borrow money was prohibited Much more drastic restrictions were imposed by the Moneylenders act, 1927. No person might send to any person, except in response to that person's written request, any advertisement containing the name, address or telephone number of a moneylender or inviting him to borrow money from a moneylender or to enter into any transaction involving such borrowing or to apply for information as to such borrowing. A moneylender may, however, advertise in newspapers and at an authorized address by poster or placard, but in each case the act severely limits the contents of the advertisement. Moreover, an advertisement or document sent in response to a written request must show with due prominence the moneylender's authorized name and any other name in which he or a partner was registered under the Moneylenders act, 1900, and must not contain expressions which might reasonably be held to imply that the moneylender carries on a banking business. If the terms of interest are indicated they must be stated at the rate per cent. per annum, or, if otherwise stated, the rate per cent. per annum represented by the interest proposed must also be shown.

By the Larceny act, 1861, advertisements of reward for the return of property stolen or lost must neither indicate that no questions will be asked or inquiries made nor promise to repay the purchaser or pledgee of stolen property. A number of statutes prohibit advertisements relating to betting and lotteries. Prize schemes used for advertising are often illegal, as being lotteries. But if skill contributes to the winning of a prize in a competition, the competition is not a lottery. Indecent and obscene advertisements were penalized by the Indecent Advertisements act, 1889.

The Cancer act, 1939, made it an offense for any person to take part in the publication of an advertisement containing an offer to treat a person for cancer, to prescribe any remedy for it or to give any advice in connection with its treatment. The Pharmacy and Medicines act, 1941, made it an offense to advertise treatments for Bright's disease, cataract, diabetes, epilepsy or fits, glaucoma, locomotor ataxia, paralysis or tuberculosis, or to advertise any article in terms calculated to lead to its use for procuring a miscarriage.

The general law also affects advertisements. False representations, offers to contract, defamatory statements, incitements to crime, contempt of court, breach of copyright and infringement of trade-marks may be contained in advertisements and will be

governed by the ordinary rules relating to deceit, contract, libel, crime and infringement of rights. The courts, however, firmly refused to allow puffing advertisements to become the basis of lawsuits between rival traders and will give a remedy for the disparagement of goods by advertisement only when false statements are made with specific reference to the plaintiff's goods, with intent to injure the plaintiff—and then only when the plaintiff has actually been involved in financial loss.

The law recognizes the value of advertisements to advertisers. Hence for breach of a contract to insert advertisements, damages will be given for the loss of business due to the failure to insert the advertisements. Similarly, where advertisement can be shown to be one of the objects of a contract—as, for instance, where an actor is engaged for a theatre of high repute—loss of publicity may be a substantial element in the damages recoverable for breach of the contract.

A summary of laws and regulations dealing with advertisements in certain other countries is contained in an official return issued by the home office in 1903.

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**ADVERTISING AGENT** or **AGENCY,** an individual or an organization engaged primarily in the preparation of advertising and also in giving counsel and assistance in the advertising and merchandising of commodities, securities and services.

Although an advertising agency, Reynell and Son, was founded as early as 1812 in London, Eng., the advertising agent first became a recognized factor in business in the United States. The *Boston Chronotype,* Oct. 16, 1846, wrote, "The newspaper advertising agency of Mr. V. B. Palmer we look upon as just the thing. You have only to step into his office with the notice which you wish to have given the whole people of the United States, and it is done." By 1849 Volney B. Palmer, who had been an editorial writer and later member of the advertising department of the *Pottsville Miner's Journal* (Pa.), had opened offices as an advertising agent in Philadelphia, New York, Baltimore and Boston. He acted as the agent for a number of publishers who paid him a commission of 25% for selling space, although he did not assume liability for the credit extended to advertisers. Palmer pioneered advertising on a national scale. His early competitors included S. M. Pettengill, a former clerk for Palmer, and John L. Hooper, who established the precedent of the agent's assuming the responsibility for paying the publisher.

In 1865 George P. Rowell, who had been a bill collector for the *Boston Post,* inaugurated his "list system." Having bought space on contract wholesale from a number of weekly newspapers, he offered space to advertisers in smaller units at retail rates which were below competitors' rates. He advertised "an-inch-of-space-a-month-in-one-hundred-papers-for-one-hundred-dollars." Although the plan proved successful for Rowell and other agents, it did not survive.

As a result of competition among agents and publishers and the flexibility of advertising rates and contracts, the agents became, in effect, expert space traders and brokers.

As late as 1880, the advertising agents relied upon the advertisers to prepare the text of their advertisements; however, in 1914 the Audit Bureau of Circulations was established, and expert and secret knowledge of circulation figures and bargaining for favourable rates were no longer the principal services offered to clients. National advertisers turned to the agencies for assistance in market research, planning of advertising campaigns and preparation of copy. By 1917, when the American Association of Advertising Agencies was founded, agencies had begun to use, in addition to publications, other media such as direct-mail soliciting and outdoor advertising. They later utilized radio and television.

Services which U.S. advertising agents generally undertook included: (1) conducting marketing researches; (2) making suggestions concerning the most saleable form of a product, including the design of the package and determination of price; (3) assisting in the organization and direction of the advertiser's sales force; (4) preparing the advertising, including copy, catalogues, mailing pieces, radio or television programs, etc., and suggesting the amount of money to be expended, the space or broadcasting time required, and the media to be used; (5) making contracts with publishers or purveyors of advertising space or time; and (6) assisting the advertiser to cultivate the good will of the trade and of the public.

As an organization, serving any number of advertisers, the agency (or agent) usually divides itself into departments as follows: (1) executive, which includes the securing of business and its development; (2) research and plans, which conducts marketing inquiries and investigations, and plans the extent and character of an advertising campaign; and (3) production, which provides for the writing and illustration of advertising copy, and the preparation of the engraving cuts and mats necessary to mechanical reproduction and other details. In addition, many agencies became responsible for the production of radio and television programs, which were designed to appeal to a given market for a product, service or, in some cases, idea.

Although U S. agencies received fees from clients for special services or materials provided, they derived most of their income at mid-20th century from the generally established commission, 15% of the standard rates, which the media voluntarily allowed. Only agencies which met the requirements for "recognition" by various publishers and publishers' associations were awarded the commission by the media owners. Requirements for recognition included agency financial responsibility for obligations to the media owners, which had to be contracted in the name of the agent or agency, and a prohibition against the agency's rebating part of the commission to the advertiser. (*See* also ADVERTISING.)

**ADVICE,** counsel given after consideration, or information from a distance giving particulars of something prospective (*e.g.*, "advice" of an imminent battle, or of a cargo due). In commerce it is a common word for a formal notice from one person concerned in a transaction to another.

**ADVOCATE,** a person called in to plead the cause of another; especially one entitled, as having the right of audience, to plead the cause of another in a court of law. In Scotland the word is used particularly to designate a member of the bar of Scotland (*see* ADVOCATES, FACULTY OF). The lord advocate is the chief law officer of the crown in Scotland. As chief public prosecutor he appoints six members of the bar to be his deputies in the conduct of criminal prosecutions, and they are termed advocate-deputies.

The lawyers who practised in the English courts of common law were never officially known as advocates, the word being reserved for those who practised in the courts of the civil and canon law (*see* DOCTORS' COMMONS). There was formerly an important official termed his majesty's advocate-general, or more shortly, the king's advocate, who was the principal law officer of the crown in the College of Advocates or Doctors' Commons, and in the admiralty and ecclesiastical courts. He discharged for these courts the duties which correspond to those of the solicitor of the treasury (*see* SOLICITOR). His opinion was taken by the foreign office on international matters, and on high ecclesiastical matters he was also consulted; all orders in council were submitted to him for approval. The office may now be said to be obsolete, for after the resignation of Sir Travers Twiss, the last holder, in 1872, it was not filled. Advocate is also the title still in use in some of the British colonies for the chief law officer of the crown.

In the United States the term advocate has no special significance but is used synonymously with such terms as attorney, counsel or lawyer.

In France, the *avocats,* as a body, were reorganized under the First Empire by a decree of Dec. 15, 1810. There is, however, a distinction between *avocats* and *avoués.* The latter, limited in number, act as procurators or agents, representing the parties before the tribunals, draft and prepare all formal acts and writings, and prepare lawsuits for the oral debates. The office of the *avocat,* on the other hand, consists in giving advice as to the law, and con-

ducting the causes of his clients by written and oral pleadings The number of *avocats* is not limited.

In Germany the *advocat* no longer forms a distinct class of lawyer. Since 1879, when a sweeping judicature act (*Deutsche Justizgesetzgebung*) reconstituted the judicial system, the *advocat* in his character of adviser, as distinguished from the *procurator*, who formerly represented the client in the courts, has become merged in the *rechtsanwalt*, who has the dual character of counsellor and pleader.

**Advocatus Ecclesiae.**—In the middle ages the word *advocatus* was used on the continent as the title of the lay lord charged with the protection and representation in secular matters of an abbey. The office is traceable as early as the beginning of the 5th century in the Roman empire, the churches being allowed to choose *defensores* from the body of advocates to represent them in the courts. In the Frankish kingdom, under the Merovingians, these lay representatives of the churches appear as *agentes, defensores* and *advocati;* and under the Carolingians it was made obligatory on bishops, abbots and abbesses to appoint such officials in every county where they held property. The office was not hereditary, the *advocatus* being chosen, either by the abbot alone, or by the abbot and bishop concurrently with the count The same causes that led to the development of the feudal system also affected the *advocatus*. In times of confusion churches and abbeys needed not so much a legal representative as an armed protector, while as feudal immunities were conceded to the ecclesiastical foundations, these required a representative to defend their rights and to fulfil their secular obligations to the state, *e g.*, to lead the ecclesiastical levies to war. A new class of *advocatus* thus arose, whose office, commonly rewarded by a grant of land, crystallized into a fief which, like other fiefs, had by the beginning of the 11th century become hereditary.

In France the *advocati* (*avoués*) were of two classes—(1) great barons, who held the advocateship of an abbey or abbeys rather as an office than a fief, though they were indemnified for the protection they afforded by a domain and revenues granted by the abbey: thus the duke of Normandy was *advocatus* of nearly all the abbeys in the duchy; (2) petty seigneurs, who held their *avoueries* as hereditary fiefs and often as their sole means of subsistence. The *avoué* of an abbey, of this class, corresponded to the *vidame* (*q.v.*) of a bishop. Their function was generally to represent the abbot in his capacity as feudal lord; to act as his representative in the courts of his superior lord; to exercise secular justice in the abbot's name in the abbatial court; to lead the retainers of the abbey to battle under the banner of the patron saint.

The *advocatus* played a more important part in the feudal polity of the Empire and of the Low [illegible] han in France, where his functions, confined to the protection of the interests of religious houses, were superseded from the 13th century onwards by the growth of the central power and the increasing efficiency of the royal administration. They had, indeed, long ceased to be effective for their original purpose; and from the time when their office became a fief they had taken advantage of their position to pillage and suppress those whom it was their function to defend. The mediaeval records, not in France only, are full of complaints by abbots of their usurpations, exactions and acts of violence.

In England *advocatus* was never used to denote the representative of an abbot; but in some of the larger abbeys there were hereditary stewards whose functions and privileges were not dissimilar to those of the continental *advocati.* The word *advocatus,* however, was in constant use in England to denote the patron of an ecclesiastical benefice, whose sole right of any importance was an hereditary one of presenting a parson to the bishop for institution. In this way the hereditary right of presentation to a benefice came to be called in English an "advowson" (*advocatio*).

In Germany the title of *advocatus* (*Vogt*) was given not only to the *advocati* of churches and abbeys, but to the officials appointed, early in the middle ages, by the emperor to administer their immediate domains, in contradistinction to the counts, who had become hereditary princes of the empire. The territory so administered was known as Vogtland (*terra advocatorum*), a name still sometimes employed to designate the strip of country which embraces the principalities of Reuss and adjacent portions of Saxony, Prussia and Bavaria These imperial *advocati* tended in their turn to become hereditary Sometimes the emperor himself assumed the title of *Vogt* of some particular part of his immediate domain. In the Netherlands as well as in Germany *advocati* were often appointed in the cities, by the overlord or by the emperor, sometimes to take the place of the bailiff (Ger *Schultheiss,* Dutch *schout,* Lat *scultetus*), sometimes alongside this official.

*See* Du Cange, *Glossarium* (ed. 1882–87, Niort), s. "Advocati", A Luchaire, *Manuel des institutions françaises* (1892). [illegible] *Realencyklopadie* (ed Leipzig, 1896), s. "Advocatus [illegible] further references will be found.

**ADVOCATES, FACULTY OF,** the collective term employed to designate the members of the bar of Scotland The faculty has grown out of the Scots act of 1532, which established the College of Justice, or Court of Session, in Scotland The advocates had, and still have, the sole right of audience in the Court of Session and High Court of Justiciary. By immemorial custom, they have formed themselves into a self-governing faculty under annually elected office-bearers consisting of the dean of faculty and his council, the vice-dean, the treasurer and the clerk. When properly instructed by a law agent an advocate is, under pain of deprivation of office, bound and entitled to plead in any court in Scotland, civil or criminal, superior or inferior. He is also entitled to plead before the House of Lords, the judicial committee of the privy council and parliamentary committees. The magnificent library collected by the faculty has now been formed into the National Library of Scotland.

**ADVOCATUS DIABOLI,** devil's advocate, the popular name for the promoter of the Faith (*promotor fidei*), an officer of the Sacred Congregation of Rites at Rome, whose duty is to prepare all possible arguments against the beatification or canonization of an alleged saint. This functionary first occurs in connection with the beatification of St. Lorenzo Giustiniani under Leo X. (1513–21). (*See* CANONIZATION.)

**ADVOWSON,** the right of presentation to a vacant ecclesiastical benefice, so called because the patron defends or advocates the claims of the person whom he presents, or because he is the advocate, patron or defender of the church and benefice and is as such given the right to name the priest. At what period the right of advowson arose is uncertain; it was probably the result of gradual growth. The earliest trace of the practice is found in the decree of the council of Orange, A.D. 441, which allowed a bishop, who had built a church in the diocese of another bishop, to nominate the clerk, but not to consecrate the church. The 123rd Novel of Justinian, promulgated about the end of the 5th century, decreed "that if any man should erect an oratory, and desire to present a clerk thereto by himself or his heirs, if they furnish a competency for his livelihood, and nominate to the bishop such as are worthy, they may be ordained." The 57th Novel empowered the bishop to examine them and judge of their qualifications, and, where those were sufficient, obliged him to admit the clerk. In England, for quite two centuries after its conversion, the clergy administered only *pro tempore* in the parochial churches, receiving their maintenance from the cathedral church, all the appointments within the diocese lying with the bishop. But in order to promote the building and endowment of parochial churches, those who had contributed to their erection either by a grant of land, by building or by endowment, became entitled to present a clerk of their own choice to the bishop, who was invested with the revenues derived from such contribution. After the Norman Conquest, it became quite usual for patrons to appoint to livings not only without the consent, but even against the will, of the bishops.

Advowsons are divided into two kinds, *appendant* and *in gross.* The right of presenting, originally given to the person who built or endowed the church, gradually became annexed to the manor in which it was built, and where the right of advowson remains attached to the manor, it is called an advowson *appendant,* and passes with the estate by inheritance or sale without any special conveyance. But where, as is now generally the case, the right of presentation has been sold by itself, and so separated from the

manor, it is called an advowson *in gross*. An advowson may also be partly *appendant*, and partly *in gross; e g*, if an owner granted to another every second presentment, the advowson would be *appendant* for the grantor's turn and *in gross* for the grantee's.

Advowsons are further distinguished into *presentative* and *collative*. In a *presentative* advowson, the patron presents a clergyman to the bishop, with the petition that he be instituted into the vacant living, and the bishop then, if the presentee be a fit clerk, admits and institutes him. In a *collative* advowson the bishop is himself the patron, either in his own right or in the right of the proper patron, which has lapsed to him through not being exercised within the statutory period of six months after the vacancy occurred Collation takes the place of presentation, admission and institution. Before 1898 there were also *donative* advowsons, but the Benefices Act, 1898, made all donations with cure of souls *presentative*. In a *donative* advowson, the patron conferred the benefice by a simple letter of gift, without any reference to the bishop.

The Benefices Act of 1898 did not make any substantial change in the legal character of advowsons, which remain practically the same as before the act. Briefly, it prevents the dealing with the right of presentation as a thing apart from the advowson itself; increases the power of the bishops to refuse the presentation of unfit persons, and removes various abuses. An advowson may, still, be sold during a vacancy, but that will not carry the right to present on the vacancy. But under the Benefices Act, advowsons may not be sold by public auction except in conjunction with landed property adjacent to the benefice; transfers of patronage must be registered in the registry of the diocese, and no such transfers can be made within 12 months after the last admission or institution to the benefice. Restrictions have also been imposed on the transfer of patronage of churches built under the Church Building acts and New Parishes acts, and on that of benefices in the gift of the lord chancellor, and sold by him in order to augment others; but agreements may be made as to the patronage of such churches in favour of persons who have contributed to their building or enlargement without being void for simony.

The Benefices Act, 1898 (Amendment) Measure, 1923, provides that after two further vacancies of the benefice subsequent to the passing of the measure, the right of patronage shall become incapable of sale, and that a patron may anticipate the two avoidances by a registered declaration, and declare the patronage shall from the date of declaration be without power of sale. The measure further provides that if a right of patronage becomes after the date of the measure vested in a clergyman or his wife, or in someone on his or her behalf, that clergyman shall not be presented to the living. There is a further provision in the measure, repealing the act called the Clergy Resignation Bonds Act, 1828, which sanctioned the giving by presentees of a bond to a patron that he would resign the benefice in favour of any one named person, or either of two named persons, if both were related to the patron within certain limited degrees.

The right of presentation may be exercised by the owners, whether they be infants, executors, trustees, coparceners (who, if they cannot agree, present in turn in order of age) or mortgagees (who must present the nominee[1] of the mortgagor), or a bankrupt (*who*, although the advowson belongs to his *creditors*, yet has the right to *present to* a vacancy). Certain owners of advowsons are temporarily or permanently disabled from exercising the right, which devolves upon other persons; and the Crown as patron paramount of all benefices can fill all churches not regularly filled by other patrons. It thus presents to all vacancies caused by simoniacal presentations, or by the incumbent having been presented to a bishopric or in benefices belonging to a bishopric when the see is vacant by the bishop's death, translation or deprivation. Where a presentation belongs to a lunatic, the lord chancellor presents for him. Where it belongs to a Roman Catholic the right is exercised in his behalf by the University of Oxford if the benefice be situate south of the River Trent, and by that of Cambridge if it be north of that river. (For the conditions which make a fit clerk *see* the article BENEFICE.) If the bishop refuses to admit and institute, the patron has his remedy by an action called after the words in the ancient writ *Quare impedit;* that is, the bishop is called upon to show "why he hinders" the patron in the exercise of his right. If the bishop's refusal be due to the fact that there is another claimant to the patronage, that person is also made defendant. If the refusal be because the clerk is alleged to be unfit, the clerk can himself appeal to the court of the metropolitan by a process known as *duplex querela*. The Benefices act also gives to both patron and presentee an alternative mode of appeal against a bishop's refusal to institute or admit, except on a ground of doctrine or ritual, to a court composed of the archbishop of the province and a judge of the high court nominated for that purpose by the lord chancellor, a course which, however, bars resort being had to the ordinary suits of *duplex querela* or action of *quare impedit*.

In case of refusal of one presentee, the patron may present another so long as he does it before lapse.

Upon institution the church is full against everybody except the Crown, and after six months' peaceable possession the clerk is secured in possession of the benefice, even though he may have been presented by a person who is not the proper patron. The true patron can, however, exercise his right to present at the next vacancy, and can recover the advowson from an usurper at any time within three successive incumbencies so created adversely to his right, or within 60 years. Collation, which otherwise corresponds to institution, does not make the church full, and the true patron can dispossess the clerk. Possession of the benefice is completed by induction, which makes the church full against any one, including the Crown. If the proper patron fails to exercise his right within six calendar months from the vacancy, the right devolves or lapses to the next superior patron; *e.g.*, from an ordinary patron to the bishop, and if he makes similar default to the archbishop, and from him on similar default to the Crown. If a bishopric becomes vacant after a lapse has accrued to it, the right goes to the metropolitan; but in case of a vacancy of a benefice during the vacancy of the see the Crown presents. Until the right of presentation so accruing to a bishop or archbishop is exercised, the patron can still effectually present but not if lapse has gone to the Crown. (*See* also BENEFICE; GLEBE; INCUMBENT; RECTOR; VICAR.)

*See* J. Mirehouse, *On Advowson* (1824); Phillimore, *Ecclesiastical Law;* J. Bingham, *Origines Ecclesiasticae, or, the Antiquities of the English Church* (1838–40). (P.)

[1] A *nomination* is to be distinguished from a *presentation*. The latter is the legal act, which alone will be recognized by the bishop. But if the legal patron be not entitled, in equity, the true patron nominates him.

**ADWAN,** a Moabite tribe claiming an Arabian origin. They declare that ten generations ago they formed part of a settled population in a fertile district of Arabia and were driven out by invaders much stronger in numbers.

See *The Cambridge Ancient History,* vol. i., 2nd ed. (1924).

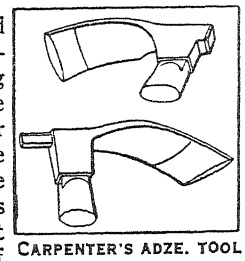
**ADY, ENDRE** (1877–1919), Hungarian poet, was born Nov. 21, 1877, at Ermindszent, Transylvania. He was a leader of the modern school and one of the greatest lyrical poets of Hungary. During his youth he became intimate with the publicists and politicians of the Radical and Socialist parties. When he settled down in Budapest he turned his attention towards revolutionary politics and contributed to several Radical papers. He also made prolonged visits to Paris and the Riviera but returned finally to Hungary owing to ill-health, and lived there quietly until his death on Jan. 27, 1919. During the World War he adopted a pacifist attitude, and prophesied the Karolyi revolution of 1918.

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**ADYE, SIR JOHN MILLER** (1819–1900), British general, son of Major James P. Adye, was born at Sevenoaks, Kent, on Nov. 1, 1819, and died on Aug. 26, 1900. Sir John Adye served in the Crimean War, in the Indian Mutiny, on the North-West frontier in India in 1863 and subsequently in important commands at home. In 1882 he was chief of staff and second in command of the expedition to Egypt and served throughout the

campaign (G. C. B. and thanks of parliament) He held the government of Gibraltar from 1883 to 1886. Promoted general and colonel commandant of the Royal Artillery in 1884, he retired in 1886. He unsuccessfully contested Bath in the Liberal interest in 1892. He was author of *Recollections of a Military Life* (1895) and other works.

**ADYTUM,** the most sacred part of a shrine, temple or church such as the Holy of Holies of the Temple at Jerusalem, or the cave of the Oracle of Apollo at Delphi, occasionally used for the chancel (*q.v.*) of a Christian church.



CARPENTER'S ADZE. TOOL WITH RAZOR-LIKE EDGE WHICH IS USED FOR CUTTING AND PLANING

**ADZE,** a tool used for cutting and planing. It is somewhat like an axe reversed, the edge of the blade curving inward and placed at right angles to the handle. This shape is most suitable for planing uneven timber, as inequalities are "hooked off" by the curved blade. At the same time, each cut of the adze leaves its own facet, giving a peculiarly wrought effect to work so finished. The beams of old houses, or of new ones finished in an old-fashioned way, show most pleasantly the marks of the adze. *See* TOOL.

**ADZHARIA** (Georgian *Achara,* Turkish *Ajaristan*), an autonomous socialist soviet republic, a zone under the protection of the Georgian S.S.R. Its boundaries are, on the west, the Black sea, on the south, Turkey, on the north and east, the Georgian S S R. Area 1,081.1 sq.mi.; pop. (1933) 153,800: urban 56,365 and rural 97,435. It consists mainly of the former military government of Batum with Ardvin, *i.e.,* the slopes and a portion of the Armenian highlands, drained by the Chorokh river and its tributary, the Acharis-Tsqali, forming deep, picturesque ravines. It is divided for administrative purposes into the following provinces: Adzhar-Tskalsk, pop. 5,524, entirely rural; Kedsk, pop. 10,307, entirely rural; Kobuletsk, pop. 16,996: urban, 1,791, rural, 15,205; Khylosk, pop. 27,172, entirely rural; Chorokh, pop. 59,199: urban, 45,450, rural, 13,749. The climate is "west coast Mediterranean" in type, with southerly and southeasterly rain-bearing winter winds from the low pressure systems over the Black sea. The Caucasus shelters it from north and northeast winds. Rainfall averages 60 in. per annum or more—at Batum 93 3 in. (maximum in November); average temperature January, 43.0° F.; August, 73.8° F. Malaria is prevalent and insect pests, *e.g.,* mosquitoes and locusts, abound. Along the coastal plains from Batum northward are cultivated vine, peach, pomegranate, fig, olive (up to 1,500 ft. above sea level), chestnut, apricot, citrus fruits, apple, pear, plum, cherry, melon and tea, maize (the staple food), wheat (up to 5,000 ft.), potatoes, peas, currants, cotton, rice, colza, tobacco, sunflower seeds and barley. The eucalyptus, mulberry (with silk cultivation), bamboo and ramie are also produced. Much of the republic is forested, the mountain slopes bearing dense forests with a great variety of timber, interspersed with climbing and twining plants and along the plains and lower slopes flowering shrubs bloom, *e g.,* magnolia, azalea, camellia japonica, begonia. Petroleum exists north of Batum, but is not worked much. Batum (*q.v.*), chief city and port, is linked by rail with Baku (on Caspian) and with Kutais and Poti. Pipes convey petroleum from Baku to Batum. Achara was at first a part of the Georgian duchy (after 1463 sovereign principality) of Guria, under the house of Gurieli. After the 16th century it became a part of the Ottoman, and after 1878 a part of the Russian, empire. In 1921 it became an A.S.S.R. (*See* GEORGIA.)

**A. E.:** *see* RUSSELL, GEORGE WILLIAM.

**AEACUS,** in Greek legend, was the son of Zeus and of Aegina, daughter of the river-god Asopus. His mother was carried off by Zeus to the island of Oenone, afterwards called by her name. The island having been depopulated by a pestilence, Zeus changed the ants upon it into human beings (Ovid, *Met.,* vii. 520), who were called Myrmidones (*murmēkes* = ants). Aeacus ruled so impartially that after his death he was made judge of the lower world, together with Minos and Rhadamanthus. His successful prayer to Zeus for rain at a time of drought was commemorated by a temple at Aegina (Pausanias ii. 29), where a festival (*Aiakeia*) was held in his honour

**AECLANUM,** an ancient town of Samnium, Italy, 15 mi E.-S E of Beneventum, on the Via Appia (near modern Mirabella). It became the chief town of the Hirpini after Beneventum had become a Roman colony Sulla captured it in 89 B C. by setting on fire its wooden breastwork, and new fortifications were erected. Hadrian, who repaired the Via Appia from Beneventum to this point, made it a colony; it has ruins of city walls, aqueduct, baths and amphitheatre; nearly 400 inscriptions have been found Two different routes to Apulia diverged at this point, one (Via Aurelia Aeclanensis) leading through the modern Ariano to Herdonie, the other (the Via Appia of the Empire) passing the Lacus Ampsanctus and going on to Aquilonia and Venusia. *See* Ashby and Gardner, *Papers of the British School at Rome,* viii 108 *sqq.*

**AEDESIUS** (d. A.D. 355), Neoplatonist philosopher, was born of a noble Cappadocian family. He went to Syria, attracted by the lectures of Iamblichus, whose disciple he became He taught at Pergamum, his chief disciples being Eusebius and Maximus

*See* Ritter and Preller, 552; Ritter's *Geschichte der Philosophie;* T. Whittaker, *The Neoplatonists* (1901).

**AEDICULA,** a small house or temple, especially the Roman household shrine of the Lares and Penates.

**AEDILES,** the magistrates at Rome who had care of the temples (*aedes*). Created in the same year as the tribunes of the people (494 B C.), they were plebeians, elected, two in number, by the *Concilium Plebis.* Intended as assistants to the tribunes, they exercised police functions and had power to inflict fines. They also managed the plebeian and Roman games. In 367 B.C. an extra day was added to the Roman games. The patricians offered to bear the expense if admitted to the aedileship. Accordingly two "curule" aediles (*see* CURULE) were appointed by the *Comitia Tributa,* at first patricians, then patricians and plebeians in turn and lastly from either class. They managed the Roman and Megalesian games, cared for the patrician temples and issued edicts for the markets. The curule aediles ranked higher than the plebeian, but in time their functions became practically identical These functions fell under three heads: (1) Care of the city—repair, etc., of temples, sewers and aqueducts; traffic regulation and precautions against fire; control of baths and taverns, and general supervision of public morals. (2) Care of provisions—testing of quality and of weights and measures; purchase of corn for disposal in emergencies at a low price. (3) Care of the games—organization of the public games and control of those given by private individuals (*e.g.,* at funerals). These were often used by ambitious persons as a means of gaining popularity. In 44 B.C. Caesar added two patrician aediles, called *Cereales,* for the care of the corn supply. Under Augustus the juridical functions of the office and the care of the games were transferred to the praetor, while its city responsibilities were limited by the appointment of a *praefectus urbi.* In the 3rd century A.D. it disappeared altogether.

*See* W. E. Heitland, *The Roman Republic* (1923), pp. 157–158; J. E. Sandys, *Companion to Latin Studies* (1921) (useful bibliography), pp. 321, 345, 385; A. H. J. Greenidge, *Roman Public Life* (1901).

**AEDUI** (ī-dŏŏ-ē), HAEDUI or HEDUI, a Gallic people of Gallia Lugdunensis, who inhabited the country between the Arar (Saône) and Liger (Loire). Their territory thus included the greater part of the modern departments of Saône-et-Loire, Côte d'Or and Nièvre. According to Livy (v. 34), they took part in the expedition of Bellovesus into Italy in the 6th century B.C. Before Caesar's time they had attached themselves to the Romans, and were honoured with the title of brothers and kinsmen of the Roman people. When the Sequani (*q.v.*), their neighbours on the other side of the Arar, subjugated them, the Aedui sent Divitiacus, the druid, to Rome to appeal for help, but his mission was unsuccessful. On his arrival in Gaul (58 B.C.), Caesar restored their independence. In spite of this, the Aedui joined the Gallic coalition against Caesar (*B.G.* vii. 42), but after the surrender of Vercingetorix at Alesia (*q.v.*) were glad to return to their allegiance. Augustus dismantled their native capital Bibracte (*q.v.*) on Mont Beuvray, and substituted a new town with a




SKETCH MAP OF THE AREA OF AEGEAN CIVILIZATION

The map shows both modern and classical names. The chief centres of Aegean civilization were in Crete and in the Peloponnese, but its influence extended over a much greater area, including the Aegean islands and parts of the coast of Asia Minor. Its middle period may, with some confidence, be placed 2,000 years before Christ, and its duration covered at least 3,000 years

half-Roman, half-Gaulish name, Augustodunum (mod. Autun). During the reign of Tiberius (A.D. 21), they revolted and seized Augustodunum, but were soon put down (Tacitus, *Ann.* iii. 43–46). The Aedui were the first of the Gauls to receive from the Emperor Claudius the distinction of the *ius honorum*.

*See* A. E. Desjardins, *Géographie de la Gaule* ii. (1876–93); T R. Holmes, *Caesar's Conquest of Gaul* (1899).

**AEGADIAN ISLANDS** (Ital. ISOLE EGADI; anc. AEGATES INSULAE), small mountainous islands off the west coast of Sicily, scene of the defeat of the Carthaginian fleet by G. Lutatius Catulus in 241 B.C., which ended the First Punic War. Favignana (Aegusa), the largest (pop. 6,186 in 1936), lies 10 mi S.W. of Trapani; Levanzo (Phorbantia) 8 mi. W. (pop. 330); Marettimo, (pop. 1,103), the ancient *ἱερὰ νῆσος*, 15 mi. W. of Trapani, is now reckoned in the group

**AEGEAN CIVILIZATION**, the general term for the prehistoric civilization, previously called "Mycenaean" because its existence was first brought to popular notice by Heinrich Schliemann's excavations at Mycenae in 1876, or "Minoan" when Sir Arthur Evans' explorations in Crete from 1899 onwards showed its main source. Subsequent discoveries, however, have made it clear that Crete was its chief centre in its earlier stages, and Mycenae, or the mainland at least, in its later stages; and, accordingly, it is more usual now to adopt a wider geographical title for this culture, which is that of Greece and the Aegean basin in the bronze age.

## I. HISTORY OF DISCOVERY AND DISTRIBUTION OF REMAINS

Mycenae and Tiryns are the two principal sites on which evidence of a prehistoric civilization was remarked by the classical Greeks. The Cyclopean walls of the citadel of Mycenae, its gate with heraldic lions, the great "treasury of Atreus" and the galleries of Tiryns had borne silent witness for ages before Schliemann's time; but they were supposed only to speak to the Homeric, or at farthest a rude Heroic beginning of purely Hellenic, civilization. Only when Schliemann exposed the contents of the graves which lay just inside the gate (*see* MYCENAE), scholars recognized the advanced stage of art to which prehistoric dwellers in the Mycenaean citadel had attained. A good deal of other evidence was available before 1876, but had not been collated and seriously studied. Although it was recognized that certain tributaries, represented, *e.g.*, in the 18th dynasty tomb of Rekhmara at Egyptian Thebes as bearing vases of peculiar forms, were of some Mediterranean race, neither their precise habitat nor the degree of their civilization could be determined while so few actual prehistoric remains were known in the Mediterranean lands. Nor did the Aegean objects which were lying obscurely in museums in 1870, or thereabouts, provide a sufficient test of the real basis underlying the Hellenic myths of the Argolid, the Troad and Crete, to cause these to be taken seriously. Both at Sèvres and Neuchâtel Aegean vases had been exhibited since about 1840, the provenance being in the one case Phylacope in Melos, in the other Cephalonia. Ludwig Ross, by his explorations in the Greek islands from 1835 onwards, called attention to certain early intaglios, since known as "island gems"; but it was not till 1878 that C. T. Newton demonstrated these to be no strayed Phoenician products. In 1866 primitive structures were discovered in the island of Therasia by quarrymen extracting pozzolana for the Suez canal works; and when this discovery was followed up on the neighbouring Santorin (Thera), by representatives of the French school at Athens, much pottery of a class now known to belong to the transition from the middle to the late bronze age, and many stone and metal objects, were found and dated by the geologist Fouqué, somewhat arbitrarily, to 2000 B.C., by consideration of the superincumbent eruptive stratum. Meanwhile, in 1868, tombs at Ialysus in Rhodes had yielded to M. A. Biliotti many fine painted vases of styles which were called later the 3rd and 4th "Mycenaean"; but these, bought by John Ruskin, and presented to the British Museum, were supposed to be of some local Asiatic fabric of uncertain date.

**Schliemann's Excavations.**—Even H. Schliemann's first excavations at Hissarlik in the Troad did not excite astonishment. But the "Burnt City" of his second stratum, revealed in 1873, with its fortifications and vases, and a hoard of gold, silver and bronze objects, which the discoverer connected with it, began to arouse a curiosity which was destined to spread far. As soon as Schliemann came on the royal "shaft graves" at Mycenae three years later, light poured from all sides on the prehistoric period of Greece. The character of both the fabric and the decoration of the Mycenaean objects was not that of any well-known art. A wide range in space was proved by the identification of the island gems and the Ialysus vases with the new style, and a wide range in time by collation of the earlier Theraean and Hissarlik discoveries. A relation between objects of art described by Homer and the Mycenaean treasures was generally allowed, and a correct opinion prevailed that, while certainly posterior, the civilization

of the *Iliad* was reminiscent of the Mycenaean Schliemann got to work again at Hissarlik in 1878, and greatly increased our knowledge of the lower strata, but did not recognize the Aegean remains in his "Lydian" city of the 6th stratum, which were not to be fully revealed till Dörpfeld resumed the work at Hissarlik in 1892 after the first explorer's death. But by laying bare in 1884 the upper stratum of remains on the rock of Tiryns (*q.v.*), Schliemann made a contribution to our knowledge of prehistoric domestic life which was amplified two years later by Chr. Tsountas's discovery of a similar palace at Mycenae. Work at Tiryns was not resumed till 1905, when it was proved, as had long been suspected, that earlier strata dating back to the beginning of the bronze age lie below the palace cleared by Schliemann From 1877 dates the finding of Mycenaean sepulchres outside the Argolid, from which, and from the continuation of Tsountas's exploration of the buildings and lesser graves at Mycenae, a large treasure, independent of Schliemann's princely gift, has been gathered into the National museum at Athens.

Between this date and the end of the century many isolated tombs of the beehive type and cemeteries of rectangular rock-cut chamber tombs were explored in different districts of Greece. Chamber tombs were found in Attica, at Spata, Markopoulo and Alyke, and in Argolis at Nauplia, and near the Argive Heraeum, and some late graves in Salamis. Beehive tombs, already rifled, but retaining some of their furniture, were excavated at Dimeni in Thessaly, Menidi and Thoricus in Attica, Orchomenus in Boeotia, and Kampos in Laconia. The richest tomb of all was cleared at Vaphio in Laconia in 1889, and this produced, in addition to a fine series of engraved gems and miscellaneous goldsmith's work, two splendid golden cups chased with scenes of bull hunting, and fragments of large vases painted in a bold florid style. These latter, with similar fragments from the Argive Heraeum, Thoricus, and Mycenae itself, remained an enigma till the excavation of Cnossus revealed the "Palace" style. The exploration of famous classical sites showed too that many of these, with the notable exception of Olympia, had been important centres of culture in Aegean times. Thus the sanctuary at Delphi, the Heraeum by Argos and the Acropolis of Athens all yielded their quota of what were still called Mycenaean objects and the last site boasts a fortification wall similar in style to those of Mycenae and Tiryns with column bases and foundations of a "palace." A Cyclopean acropolis and "palace" were explored on the island of Goulas in Lake Copais, the prehistoric dykes of which were now surveyed. Mycenaean remains came to light in most parts of Greece, but except for Eleusis, Aegina and Thoricus, where little was done, no inhabited sites were touched. At these last three sites pottery of new types was found which we now know to be pre-Mycenaean; but this and the discovery by Wide in 1894 in a barrow at Aphidna of burials containing similar wares remained almost unnoticed. Similarly some early rock-cut tombs with peculiar hand-made pottery found in the American excavations at Corinth in 1896 did not fall into their right context till the discoveries at Korakou, near Corinth, almost 20 years later.

**Excavation Outside Greece.**—Meanwhile prehistoric research had begun to extend beyond the Greek mainland. Certain central Aegean islands, Antiparos, Ios, Amorgos, Syros and Siphnos, were all found to be singularly rich in evidence of the early Aegean period. The series of Syran-built graves, containing crouching corpses, is the most representative known in the Aegean. Exceptionally rich cemeteries of the same date have been explored in Naxos, and Paros has yielded in addition to early graves some remains of the middle period. Delos too has proved an unexpected source of early Aegean culture. Melos, long marked as a source of early objects, but not systematically excavated till taken in hand by the British school at Athens in 1896, yielded at Phylacope remains of all the Aegean periods, except the Neolithic. Numerous cemeteries with late Aegean pottery have been found in Rhodes. A map of Cyprus in the later Bronze Age (such as is given by J. L. Myres and M. O. Richter in *Catalogue of the Cyprus Museum*) shows more than 25 settlements in and about the Mesaorea district alone, of which one, that at Enkomi, near the site of Salamis, has yielded the richest Aegean treasure in precious metal found outside Argolis E Gjerstad (*Studies on Prehistoric Cyprus*) has since added to the number of prehistoric sites in the island, the relationship of which to the general Aegean culture is gradually becoming clearer. In Asia Minor a cemetery at Yortan in Mysia and Korte's excavations at Gordium in Phrygia have yielded pottery similar to that from the early strata of Hissarlik Exploration of south-western Asia Minor has also brought to light remains of the prehistoric age; but though pottery of late Aegean style is found along the coast and ceramic specimens of Aegean appearance have often been brought back from many districts of Anatolia, the connections of Asia Minor and of Hissarlik (Troy) still seem, so far as the early and middle Aegean periods are concerned, to lie outside the Aegean area proper (*see* TROY). In Egypt in 1887 W. M. F. Petrie found painted sherds of Cretan style at Kahun in the Fayum, and farther up the Nile, at Tell el-Amarna, chanced on bits of no fewer than 800 Aegean vases in 1889. Much material from subsequent excavations has accumulated to demonstrate that Egypt and the Aegean were in contact from early dynastic times. There have now been recognized in the collections at Cairo, Florence, London, Paris and Bologna several Egyptian imitations of the Aegean style which can be set off against the many debts which the centres of Aegean culture owed to Egypt. Two Aegean vases were found at Sidon in 1885, and many fragments of Aegean and especially Cypriote pottery have been turned up during recent excavations of sites in Philistia and Palestine. Indeed the typical Philistine pottery is derived from the latest Aegean fabric. South-eastern Sicily, ever since P. Orsi excavated the Sicel cemetery near Lentini in 1877, has proved a mine of early remains, among which appear in regular succession Aegean decorative motives from the period of the second stratum at Hissarlik. Vases of the last Aegean period have also been found. Aegean objects too have been reported from Sardinia, although the Aegean influence formerly thought to have been observed in Spain, is now discredited or at least considered much overrated.

One land, however, has eclipsed all others in the Aegean by the wealth of its remains of all the prehistoric ages; viz., Crete, so much so that, for the present, we must regard it as the fountain-head of Aegean civilization, and probably for long its political and social centre. The island first attracted the notice of archaeologists by the remarkable archaic Greek bronzes found in a cave on Mt. Ida in 1885, as well as by epigraphic monuments such as the famous law of Gortyna; but the first undoubted Aegean remains reported from it were a few objects extracted from Cnossus by Minos Kalokairinos of Candia in 1878. These were followed by important discoveries made in the southern plain (Messará) by F. Halbherr. W. J. Stillman and H. Schliemann both made unsuccessful attempts at Cnossus, and A. J. Evans, coming on the scene in 1893, travelled in succeeding years about the island picking up trifles of unconsidered evidence, which gradually convinced him that greater things would eventually be found. He obtained enough to enable him to forecast the discovery of written characters, till then not suspected in Aegean civilization. The revolution of 1897–98 opened the door to wider knowledge, and much exploration has ensued, for which *see* CRETE.

**Further Mycenaean Investigations.**—The success of the excavations in Crete naturally caused fresh attention to be paid to Mycenaean remains on the mainland. At Thebes the ruins of the "House of Cadmus" were found by Keramopoullos and yielded many fragments of brilliant frescoes and a store of inscribed vases of the latest period; while close to the city, chamber tombs, stored with vases and other funeral furniture, were excavated. At Orchomenos the Mycenaean stratum was explored by Furtwängler and the underlying strata, which reach down to the neolithic deposits, began to reveal for the first time the pre-Mycenaean history of the mainland. Wares of the early and middle Aegean periods were unearthed at Aegina and the later continuance of the work there has much enlarged our knowledge and shown that the town was protected by a wall. Imported Cretan ware of the middle period has also come to light. At Tiryns many fragments of frescoes from the palace were found, and in the strata beneath the palace floor, reaching down to bed rock,

remains of the middle and early periods appeared Further beehive tombs were excavated at Kakovatos at the Messenian Pylos and at Tiryns, but the last had unfortunately been completely plundered at least by Roman times. More evidence for the last period came in from Argos, where the middle period also appeared, Achaea, Aetolia, Locris, and Cephalonia showing that culture all over Greece in the late bronze age had been more or less uniform.

Meanwhile in Thessaly discoveries were being made which were to give a new aspect to the pre-history of Greece. Here rich deposits of painted neolithic pottery were found at Dimini and Seskio by Tsountas, who cleared some small beehive tombs of the transitional period between the bronze and iron ages at Marmariane. Further systematic excavation of other sites in Thessaly by British archaeologists and researches by Soteriades in Boeotia and Phocis showed that the neolithic pottery of the Greek mainland was totally different from that of Crete and therefore that the underlying basis for the bronze age in these two main spheres of Aegean culture was by no means the same. This was supported by the results obtained by Dörpfeld in Leucas, where he found wares of all three periods (early, middle and late) and neolithic pottery with painted decoration closely akin to the Thessalian. Euboea produced tombs of the early bronze age, showing a [illegible] both to the wares of the Cyclades and to those of [illegible] and more tombs of the late period which indicate that the results obtained in this island coincide with those from elsewhere. Even before the war the American excavators had obtained hints that Corinth was likely to prove fertile in pre-historic remains, but not till 1915 was any great success won. Since that year the Americans under the leadership mainly of Blegen and Miss Walker have rewritten the early history of the mainland. A series of discoveries and excavations has shown that neolithic wares similar to those of Thessaly are to be found in the Peloponnese, where Corinth, Nemea, the Argive Heraeum and Arcadia have all yielded relics of this period. Further, largely as the result of the excavation of Korakou, a prehistoric port on the Gulf of Corinth near Lechaeum, supported by fruitful work at Zygouries (near Cleonae), Nemea and the Argive Heraeum, it has been possible to obtain a clear view of the three stages of the bronze age on the mainland.

**The Aegean Area.**—Traces of the early and middle bronze ages have also appeared in Laconia, and the German work at Amyclae has yielded many relics of the late period. At Asine, near Nauplia, a Swedish expedition under Persson has achieved brilliant results and recovered remains of all three periods. The same expedition at Dendra, near Midea, has excavated an unplundered beehive tomb which shows the burial ritual and found treasures richer than those of Vaphio. There is a splendid gold cup chased with a design of octopuses and dolphins, a gold and silver cup adorned with bulls' heads, silver cups, weapons of bronze, engraved sealstones of wondrous size, and pottery which dates the tomb to about 1350 B.C., the last period. Nearby is a chamber tomb, with a hoard of 33 bronze vessels, which, though empty of human remains, seems to have been a cenotaph and throws much light on the cult of the dead. At Mycenae the British work directed by Wace has found remains of all three periods of the bronze age, including a rich series of tombs of the last period, and established the history of the shaft graves found by Schliemann. The palace has been re-explored and, with the Lion Gate and walls, been found to date from the latter part of the last period, from 1400 B.C. The beehive tombs, also re-examined, can be dated with some degree of probability, and the finest, such as the Treasury of Atreus are seen to be contemporary with the Lion Gate. These results are confirmed by the renewed work of the Germans at Tiryns under Karo and Kurt Müller, who find that the palace and the walls, with three stages at least, are approximately contemporary with those of Mycenae. The Swedish finds at Dendra and in the beehive tombs of Bodia, in Messenia, agree with these conclusions, which all tend to show that after the fall of Cnossus, about 1400 B.C., Mycenae as the chief stronghold of the mainland succeeded to the Aegean empire and spread Aegean culture far and wide.

Further work in Boeotia at Eutresis and other sites has extended our knowledge of the houses and culture of the two first periods, and on the Acropolis of Athens itself neolithic pottery of the Thessalian type has come to light as well as pottery of the early bronze age. The latest revelation comes from Samos, where bronze age pottery of the middle and late periods, it is said, has been discovered. Thus on the one hand new discoveries have emphasized the uniform and widespread character of the Aegean culture throughout the area, and on the other hand the latest finds on the mainland indicate considerable divergence between it and Crete. The last point is of vital importance in considering the historical and ethnological problems of Greece in the Aegean or prehistoric age. The "Aegean Area" now covers the Archipelago with Crete and Cyprus, the Hellenic peninsula with the Ionian isles, and western Anatolia. Evidence is also coming in from the Macedonian coast Offshoots are found in the western Mediterranean, in Sicily, Italy, Sardinia, and in the East in Palestine and Egypt. About the Cyrenaica we are still insufficiently informed.

## II. GENERAL NATURE OF THE EVIDENCE

For details of monumental evidence the articles on CRETE, MYCENAE, TIRYNS, TROY, CYPRUS, etc., must be consulted. The most representative site explored up to now is Cnossus, which has yielded the most various and the most continuous evidence from the Neolithic age to the twilight of classical civilization. Next in importance are in Crete, Phaestus, Agia Triada, Mochlos, Vasilike, Tylissus, Gournia, Mallia and the tombs of Mesara; on the mainland, after Mycenae, Tiryns, Thebes, Asine, Korakou and the other sites already mentioned, are Agia Marina, Lianokladi and Tsangli; in the islands, Phylacope in Melos, and on the Anatolian littoral Hissarlik (Troy).

A. The *internal* evidence at present available comprises:—

(1) *Structures.*—Ruins of palaces, palatial villas, houses, built dome- or cist-graves and fortifications (Aegean isles, Greek mainland and north-west Anatolia), but not distinct temples; small shrines, however, and *temenê* (religious enclosures, remains of one of which were probably found at Petsofa, near Palaikastro, by J. L. Myres in 1904) are represented on intaglios and frescoes. From like sources and from inlay-work we have also representations of palaces and houses.

(2) *Structural Dècoration.*—Architectural features, such as columns, friezes and various mouldings; mural decoration, such as fresco-paintings, coloured reliefs and mosaic inlay.

(3) *Furniture.*—(*a*) *Domestic,* such as vessels of all sorts and in many materials, from huge store-jars down to tiny unguent pots; culinary and other implements; thrones, seats, tables, etc , these all in stone or plastered terra-cotta; (*b*) *Sacred,* such as models or actual examples of ritual objects; of these we have also numerous pictorial representations; (*c*) *Funerary; e.g.,* coffins in painted terra-cotta

(4) *Artistic Fabrics, e.g.,* plastic objects, carved in stone or ivory, cast or beaten in metals (gold, silver, copper and bronze), or modelled in clay, faience, paste, etc. No trace has yet been found of large free sculpture, but many examples exist of sculptors' smaller work. Vases of all kinds, carved in marble or other stones, cast or beaten in metals or fashioned in clay, the latter in enormous number and variety, richly ornamented with coloured schemes, and sometimes bearing moulded decoration. Examples of painting on stone, opaque and transparent. Engraved objects in great number; *e g.,* ring-bezels and gems; and an immense quantity of clay impressions, taken from these.

(5) *Weapons, tools and implements,* in stone, clay and bronze, and at the last iron, sometimes richly ornamented or inlaid. Numerous representations also of the same. No actual body-armour, except such as was ceremonial and buried with the dead, like the gold breastplates in the circle-graves at Mycenae.

(6) *Articles of personal use, e.g.,* brooches (*fibulae*), pins, razors, tweezers, etc., often found as dedications to a deity; *e.g.,* in the Dictaean cavern of Crete. No textiles have survived.

(7) *Written documents; e.g.,* clay tablets and discs (so far in Crete only), but nothing of more perishable nature, such as skin, papyrus, etc.; engraved gems and gem impressions; legends writ-

ten with pigment on pottery (rare); characters incised on stone or pottery. These show two main systems of script (*see* CRETE).

(8) *Excavated tombs*, of either the pit or the grotto kind, in which the dead were laid, together with various objects of use and luxury, without cremation, and in either coffins or *loculi* or simple wrappings.

(9) *Public works*, such as paved and stepped roadways, bridges, systems of drainage, etc.

B. There is also a certain amount of *external* evidence to be gathered from:—

(1) Monuments and records of other contemporary civilizations; *e.g.*, representations of alien peoples in Egyptian frescoes; imitation of Aegean fabrics and style in non-Aegean lands; allusions to Mediterranean peoples in Egyptian, Hittite, Semitic or Babylonian records.

(2) Literary traditions of subsequent civilizations, especially the Hellenic, such as, *e g.*, those embodied in the Homeric poems, the legends concerning Crete, Mycenae, etc.; statements as to the origin of gods, cults and so forth, transmitted to us by Hellenic antiquarians such as Strabo, Pausanias, Diodorus, Siculus, etc.

(3) Traces of customs, creeds, rituals, etc., in the Aegean area at a later time, discordant with the civilization in which they were practised and indicating survival from earlier systems. There are also possible linguistic and even physical survivals to be considered.

### III. GENERAL FEATURES OF AEGEAN CIVILIZATION

The leading features of Aegean civilization, as deduced from the evidence must be stated very briefly.

(1) **Political Organization.**—The great Cretan palaces and the fortified citadels of Mycenae, Tiryns and Hissarlik, each containing little more than one great residence, and dominating lower towns of meaner houses, point to monarchy at all periods. Independent local developments of art before the middle of the 2nd millennium B.C. suggest the early existence of independent units in various parts, of which the strongest was the Cnossian. After that date the evidence goes strongly to show that one political dominion was spread for a brief period, or for two brief periods, over almost all the area (*see* later). The great number of tribute tallies found at Cnossus perhaps indicates that the centre of power was there for some time.

(2) **Religion.**—The fact that shrines have so far been found within palaces and not certainly anywhere else indicates that the kings kept religious power in their own hands; perhaps they were themselves high-priests. Religion in the area seems to have been essentially the same everywhere from the earliest period; viz., the cult of divine principles, resident in dominant features of nature (sun, stars, mountains, trees, etc.) and controlling fertility. This cult passed through an aniconic stage, from which fetishes survived to the last, these being rocks or pillars, trees, weapons (*e.g.*, *bipennis*, or double war-axe, shield), etc. When the iconic stage was reached, about 2000 B.C., we find one divine spirit represented as a goddess with a subordinate young god, as in many other eastern Mediterranean lands. The god was probably son and mate of the goddess, and the divine pair represented the genius of reproductive fertility in its relations with humanity. The goddess at times appears, with doves, as uranic, at others with snakes, as chthonic. In the ritual fetishes, often of miniature form, played a great part: all sorts of plants and animals were sacred; sacrifice (not burnt, and human very doubtful), dedication of all sorts of offerings and *simulacra* invocation, etc., were practised. The dead were objects of a sort of hero-worship especially on the mainland. This early nature-cult, explains many anomalous features of Hellenic religion, especially in the cults of Artemis and Aphrodite (*see* CRETE).

(3) **Social Organization.**—There is a possibility that features of a primeval matriarchate long survived; but there is no certain evidence. Of the organization of the people under the monarch we are ignorant. There are so few representations of armed men that it seems doubtful if there can have been any professional military class. Theatral structures found at Cnossus and Phaestus, within the precincts of the palaces, were perhaps used for shows or for sittings of a royal assize, rather than for popular assemblies. The Cnossian remains contain evidence of an elaborate system of registration, account-keeping and other secretarial work, which perhaps indicates a considerable body of law. The life of the ruling class was comfortable and even luxurious from early times. Fine stone palaces, richly decorated, with separate sleeping apartments, large halls, ingenious devices for admitting light and air, sanitary conveniences and marvellously modern arrangements, for supply of water and for drainage, attest this fact. Even the smaller houses, after the Neolithic period, seem also to have been of stone, plastered within. After 1600 B.C. the palaces in Crete had more than one storey, fine stairways, bath-chambers, windows, folding and sliding doors, etc. In this later period, the distinctions of blocks of apartments in some palaces has been held to indicate the seclusion of women in *harems*, at least among the ruling caste. Cnossian frescoes show women grouped apart, and they appear alone on gems. Flesh and fish and many kinds of vegetables were evidently eaten, and wine and beer were drunk. Vessels for culinary, table and luxurious uses show an infinite variety of form and purpose. Artificers' implements of many kinds were in use, bronze succeeding obsidian and other hard stones as the material. Seats are found carefully shaped to the human person. There was evidently olive- and vine-culture on a large scale. Chariots were in use in the later period, as is proved by the pictures of them on Cretan tablets and at Mycenae, Tiryns and Vaphio, and therefore the horse was known. Main ways were paved. Sports, probably more or less religious, are often represented; *e.g.*, bull-fighting, dancing, boxing and armed combats.

(4) **Commerce** was practised to some extent in very early times, as is proved by the distribution of Melian obsidian over most of the Aegean area and by the Nilotic influence on early Minoan art. We find Cretan vessels exported to Melos, Egypt and the Greek mainland. Melian vases came in their turn to Crete After 1600 B.C. there is very close intercourse with Egypt, and Aegean things find their way to all coasts of the Mediterranean (*see* below). No traces of currency have come to light, unless certain axe-heads too slight for practical use, had that character; but standard weights have been found, and representations of ingots. The Aegean written documents have not yet proved (by being found outside the area) epistolary correspondence with other lands. Representations of ships are not common, but several have been observed on Aegean gems, [illegible] and vases. There are also leaden and clay models of [illegible] are vessels of low free-board, with masts. Familiarity with the sea is proved by the free use of marine motives in decoration.

(5) **Treatment of the Dead.**—The dead in the earlier period were laid (so far as we know at present) within cists constructed of upright stones. These were sometimes inside caves and occasionally clay coffins were used. After the burial the cist was covered in with earth. A little later, in Crete, bone pits seem to have come into use, containing the remains of many burials. Possibly the flesh was boiled off the bones at once ("scarification"), or left to rot in separate cists awhile; afterwards the skeletons were collected and the cists re-used. The royal shaft graves at Mycenae are an elaboration of the simple cist grave and the circle surrounding them finds a parallel in the grave rings at Leucas. Chamber tombs built in the early period occur in Crete and rock-cut tombs of the same general type approached by a horizontal or slightly inclined way with the sides converging above are very common on the mainland and in Rhodes in the last period, and are often found in Crete where small clay coffins containing skeletons in a crouching posture are usual. Circular ossuaries which some believe to have been roofed with vaults, occur in Crete in the early period and last into the beginning of the middle period; but the great beehive tombs of Mycenae and the mainland belong to the last period (from about 1500 B.C. onwards) and the finest, such as the treasury of Atreus, to the concluding phase of the bronze age after the fall of Crete about 1400 B.C. Sometimes in Crete at the end of the middle period the dead were trussed up and thrust head foremost into

large jars for burial. On the mainland at a slightly earlier date children are found buried in jars, and sometimes in place of stone cists the dead were surrounded by walls of crude brick or covered with fragments of large store jars. At no period do the Aegean dead seem to have been burned. Weapons, food, water, unguents and various trinkets were laid with the corpse at all periods In the Mycenae circle an altar seems to have been erected over the graves, and on the mainland at least there are definite traces of the worship of the dead A painted sarcophagus, found at Hagia Triada, also possibly shows a hero-cult of the dead.

(6) **Artistic Production.**—Ceramic art reached a specially high standard in fabric, form and decoration by the middle of the 3rd millennium B.C in Crete. The products of that period compare favourably with any potters' work in the world. The same may be said of fresco-painting and probably of metal work. Modelling in terra-cotta, stone and ivory, engraving on gems, were following it closely by the beginning of the 2nd millennium. After 2000 B C. all these arts revived, and sculpture, as evidenced by relief work, both on a large and on a small scale, carved stone vessels, metallurgy in gold, silver and bronze, advanced farther. This art and those of fresco- and vase-painting and of gem engraving stood higher about the 15th century B.C. than at any subsequent period before the 6th century. The manufacture, modelling and painting of faience objects, and the making of inlays in many materials were also familiar to Aegean craftsmen, who show in all their best work a strong sense of natural form and an appreciation of ideal balance and decorative effect, such as are seen in the best products of later Hellenic art. Architectural ornament was also highly developed The richness of the Aegean capitals and columns may be judged by those from the "Treasury of Atreus" now set up in the British Museum; and of the friezes we have examples in Mycenaean and Cnossian fragments, and Cnossian paintings. The magnificent gold work of the later period, preserved to us at Mycenae, Dendra and Vaphio, needs only to be mentioned. It should be compared with stone work in Crete, especially the steatite vases with reliefs found at Hagia Triada. On the whole, Aegean art, at its two great periods, in the middle of the 3rd and 2nd millennia respectively, will bear comparison with any contemporary arts.

## IV. ORIGIN, NATURE AND HISTORY OF AEGEAN CIVILIZATION

The evidence, summarized above, though very various and voluminous, is not yet sufficient to answer all the questions which may be asked as to the origin, nature and history of this civilization, or to answer any but a few questions with absolute certainty.

A. **Distinctive Features.**—The fact that Aegean civilization is distinguished from all others, prior or contemporary, not only by its geographical area, but by leading organic characteristics, has never been in doubt since its remains came to be studied seriously and impartially. The truth was indeed obscured for a time by persistent prejudices in favour of certain alien Mediterranean races long known to have been in relation with the Aegean area in prehistoric times; *e.g.*, the Egyptians and especially the Phoenicians. Others put forward "Achaeans" from the north as its authors. But such claims to the authorship of the Aegean remains grew fainter with every fresh Aegean discovery and every new light thrown on their own proper products; with the Cretan revelations they ceased altogether to be considered except by a few Homeric enthusiasts. Briefly, we now know that the Aegean civilization developed these distinctive features: (1) An *indigenous script* expressed in characters of which only a very small percentage are identical, or even obviously connected, with those of any other scripts. This is equally true both of the pictographic and the linear Aegean systems. Its nearest affinities are with the "Asianic" scripts, preserved to us by Hittite, Cypriote and south-west Anatolian (Pamphylian, Lycian and Carian) inscriptions. But neither are these affinities close enough to be of any practical aid in deciphering Aegean characters, nor is it by any means certain that there is parentage. The Aegean script may be, and probably is, prior in origin to the "Asianic"; and it may equally well be owed to a remote common ancestor, or (the small number of common characters being considered) be an entirely independent evolution from representations of natural objects (*see* CRETE). (2) An *Art*, whose products cannot be confounded with those of any other known art by a trained eye. Its obligations to other contemporary arts are many and obvious, especially in its later stages; but every borrowed form and motive undergoes an essential modification at the hands of the Aegean craftsman, and the product is stamped with a new character. The secret of this character lies evidently in a constant attempt to express an ideal in forms more and more closely approaching to realities. We detect the dawn of that spirit which afterwards animated Hellenic art. The fresco-paintings, ceramic motives, reliefs, free sculpture and toreutic handiwork of Crete have supplied the clearest proof of it, confirming the impression already created by the goldsmiths' and painters' work of the Greek mainland (Mycenae, Thebes, Vaphio, Dendra, Tiryns). (3) *Architectural plans and decoration.* The arrangement of Aegean palaces is of two main types. First (and perhaps earliest in time), the chambers are grouped round a central court, being engaged one with the other in a labyrinthine complexity, and the greater oblongs are entered from a long side and divided longitudinally by pillars. Second, the main chamber is of what is known as the *megaron* type; *i.e.*, it stands free, isolated from the rest of the plan by corridors, is entered from a vestibule on a short side, and has a central hearth, surrounded by pillars and perhaps hypaethral; there is no central court, and other apartments form distinct blocks In spite of many comparisons made with Egyptian, Babylonian and "Hittite" plans, both these arrangements remain incongruous with any remains of prior or contemporary structures elsewhere. Whether either plan suits the "Homeric" palace does not affect the present question. (4) A *type of tomb*, the dome or "beehive," of which the grandest examples known are at Mycenae. The Cretan "larnax" coffins, also, have no parallels outside the Aegean. There are other infinite singularities of detail; but the above are more than sufficient to establish the point.

B. **Origin and Continuity.**—With the immense expansion of the evidence, due to the Cretan excavations, a question arises how far the Aegean civilization, whose total duration covers at least 3,000 years, can be regarded as one and continuous. The exploration of Cnossus shows that Aegean civilization had its roots in a primitive Neolithic period, of uncertain but very long duration, represented by a stratum which (on that site in particular) is in places nearly 20ft thick, and contains stone implements and sherds of hand-made and hand-polished vessels, showing a progressive development in technique from bottom to top. This Cnossian stratum seems to be throughout earlier than the lowest layer at Hissarlik. It closes with the introduction of incised, white-filled decoration on pottery, whose motives are presently found reproduced in monochrome pigment. We are now in the beginning of the bronze age, and the first of Evans's "Minoan" periods. Thereafter, by exact observation of stratification, eight more periods have been distinguished at Cnossus, each marked by some important development in the universal and necessary products of the potter's art, the least destructible and therefore most generally used archaeological criterion. These periods fill the whole bronze age, with whose close, by the introduction of the superior metal, iron, the Aegean age is conventionally held to end. Iron came into general Aegean use about 1000 B.C., and possibly was the means by which a body of northern invaders established their power on the ruins of the earlier dominion. The important point is this, that throughout the nine Cnossian periods, following the Neolithic age (named by Evans, "Minoan I. 1, 2, 3; II. 1, 2, 3; III. 1, 2, 3"; *see* CRETE), there is evidence of a perfectly orderly and continuous evolution in, at any rate, ceramic art. From one stage to another, fabrics, forms and motives of decoration develop gradually; so that, at the close of a span of more than 2,000 years, at the least, influences of the beginning can still be clearly seen and no trace of violent artistic intrusion can be detected. This fact, by itself, would go far to prove that the civilization continued fundamentally and essentially the same throughout. It is, moreover, supported by less abundant remains

of other arts. That of painting in fresco, for instance, shows the same orderly development from at any rate Period II. 2 to the end. About institutions we have less certain knowledge, there being but little evidence for the earlier periods; but in the documents relating to religion, the most significant of all, there is no trace of sharp change. We see evidence of a uniform nature worship passing through all the normal stages down to theoanthropism in the latest period. There is no appearance of intrusive deities or cult-ideas. We may take it then (and the fact is not disputed even by those who believe in one thorough racial change, at least, during the bronze age) that the Aegean civilization was indigenous, firmly rooted and strong enough to remain dominant in its own geographical area throughout the bronze age.

This conclusion does not necessarily lead to the corollary that the mass of those who possessed this civilization remained for the most part racially the same throughout the bronze age. This indeed may be true for Crete, but as already indicated there are grave reasons for believing that on the mainland matters were not so simple, and herein lies the crux of Greek ethnology. A solution which would satisfy the archaeological and anthropological problems to be indicated would go far to solving the vexed questions of Hellenic origins, especially as regards Achaeans and Dorians (*see* DORIANS, ACHAEANS and IONIANS), and the first appearance of Aryans in the peninsula. In the neolithic age the general characteristics of the culture of the mainland and of Crete are quite distinct. On the mainland at the end of the neolithic age a bronze-using culture appears which is undoubtedly akin to that of the islands and Crete. In the middle period, however, about 2000 B.C., a new element comes into the mainland typified for archaeologists by a well marked class of pottery called "Minyan Ware." This occurs as an import into Melos and was even imitated there, but though contemporary Melian wares are recognized in Crete, as in the temple repositories at Cnossus, hardly a sherd of Minyan ware has been found in Crete. Suddenly, just before the beginning of the last period, Cretan influence and culture came in full force to the mainland. Some hold that this betokens a complete conquest of the mainland by Crete, wholesale displacements of population and the institution of Cretan dynasts at Mycenae and elsewhere. Others maintain that this indicates a rapid absorption by a vigorous and progressive folk of a developed culture which they adapted to their own purposes. For the latter view we can urge:—

(1) Distinct differences are observed between the products of the mainland and those of Crete and both, for instance, appear as imports in Melos side by side; (2) the oldest royal grave at Mycenae contains mostly mainland pottery, and throughout the succeeding period, though the superficial culture is Cretan, there are clear signs that its basis is the old element which produced Minyan ware; (3) there is a variation in burial customs between Crete and the mainland pointing to a divergence in belief as regards the dead; (4) the fortified castles of the mainland like Mycenae, Tiryns and Midea are in strong contrast to the undefended palaces of Crete; (5) in the earlier periods Cretan pottery, except in a few cases, has not been found outside, but the adoption of the Cretan phase of Aegean culture by the mainland just precedes the spread of the last phase of that culture far and wide in the Levant, and it is notorious that the remains from Rhodes, Cyprus and Philistia depend on the mainland and not on Crete.

All this suggests that about 1600 B.C. when the last period began some powerful folk (that which introduced Minyan pottery) arose on the mainland and quickly absorbed the mature Aegean culture of Crete, and soon after, when Crete collapsed, about 1400 B.C., the mainlanders became the dominant force and spread their version of Aegean culture abroad. The recent discoveries that the walls and palaces of Tiryns and Mycenae belong to the last phase after 1400 B.C. support this view, as also the other conclusion which places the greatest achievements of Aegean architecture, like the treasury of Atreus, in this the culminating phase of the Aegean culture, which closed perhaps with the great armada led against Troy.

A good deal of anthropometric investigation has been devoted to human remains of the Aegean epoch, especially to skulls and bones found in Crete in tombs of Period II. The result of this, however, has established the fact that the Aegean races, as a whole, belonged to the dark, long-headed *Homo Mediterraneus*—a fact only valuable in the present connection in so far as it tends to discredit an Asiatic source for Aegean civilization, though there was clearly much affinity between Crete and south-western Asia Minor. From the skull-forms studied, it would appear, that the Aegean race was by no means pure even in the earlier Minoan periods. On the mainland indeed the skulls from Asine show that both the long and the short types were present in the middle period together with one or two examples of an "Armenoid" character. This is by no means in disagreement with archaeology. There is some ground for supposing that the language spoken in Crete before the later Doric was non-Hellenic, though perhaps Indo-European. This inference rests on three inscriptions in Greek characters but non-Greek language found in eastern Crete. The language has some apparent affinities with Phrygian. The inscriptions are post-Aegean by many centuries, but they occur in the part of the island known to Homer as that inhabited by the Eteo-Cretans, or aborigines. Their language may prove to be that of the Linear tablets.

## V. HISTORY OF AEGEAN CIVILIZATION

History of an inferential and summary sort only can be derived from monuments in the absence of written records. The latter do, indeed, exist in the case of the Cretan civilization and in great numbers; but they are undeciphered and likely to remain so, except in the improbable event of the discovery of a long bilingual text, partly couched in some familiar script and language. Even in that event, the information which would be derived from the Cnossian tablets would probably make but a small addition to history, since in very large part they are evidently mere inventories of tribute and stores. The engraved gems probably record divine or human names (*see* CRETE).

(1) **Chronology.**—The first chronological datum is inferred from a close similarity between certain Cretan hand-made and polished vases of Minoan Period I. 1. and others discovered by Petrie at Abydos in Egypt and referred by him to the 1st dynasty. He goes so far as to pronounce the latter to be Cretan importations, their fabric and forms being unlike anything Nilotic. If that be so, the period at which stone implements were beginning to be superseded by bronze in Crete must be dated before 4000 B.C. But below all Evans's "Minoan" strata lies the immensely thick Neolithic deposit. To date the beginning of this earliest record of human production is impossible at present. The Neolithic stratum varies very much in depth, ranging from nearly 20ft. to 3ft., but is deepest on the highest part of the hillock. Its variations may be due equally to natural denudation of a stratum once of uniform depth, or to the artificial heaping up of a mound by later builders. Even were certainty as to these alternatives attained, we could only guess at the average rate of accumulation, which proceeds very differently on different sites and under different social and climatic conditions. In later periods at Cnossus accumulation seems to have proceeded at a rate of, roughly, 3ft. per 1,000 years. Reckoning by that standard we might push the earliest Neolithic remains back behind 10,000 B.C.; but the calculation would be worthy of little credence. Surer chronological links are provided by the close affinity with early dynastic Egyptian products shown by the stone bowls from tombs of the 1st period at Mochlos and in Mesara. At Cnossus actual Egyptian bowls of the earliest dynastic times have been found. These facts, and the parallelism displayed by Cretan seals in ivory and stone from the Mesara ossuaries and by Egyptian seals of the 1st six dynasties, enable us to say that the 1st period began before the middle of the 4th millennium. We reach another fairly certain date in the synchronism of remains belonging to the 12th dynasty (*c.* 2225 B.C.) with products of Minoan Period II. 2. Characteristic Cretan pottery of this period was found by Petrie in the Fayum and by Garstang at Abydos in conjunction with 12th dynasty remains, and various Cretan products of the period show striking coincidences with 12th dynasty styles, especially

in their adoption of spiraliform ornament The spiral, however, occurs so often in natural objects (*e g*, horns, climbing plants, shavings of wood or metal) that too much stress must not be laid on the mutual parentage of spiraliform ornament in different civilizations. A diorite statuette, referable by its style and inscription to Dynasty 13, was discovered in deposit of Period II. 2. in the central court, and a cartouche of the "Shepherd King," Khyan, was also found at Cnossus. He is usually dated about 1633 B.C. This brings us to the next and most certain synchronism, that of Minoan Periods III. 1, 2, with Dynasty 18 (*c.* 1600–1400 B.C.). This coincidence has been observed not only at Cnossus, but previously, in connection with discoveries of scarabs and other Egyptian objects made at Mycenae, Ialysus, Enkomi, etc. In Egypt itself Kefti tributaries, bearing vases of Aegean form, and themselves similar in fashion of dress and arrangement of hair to figures on Cretan frescoes and gems of Period III, are depicted under this and the succeeding dynasties (*e.g.*, Rekhmara tomb at Thebes). Actual vases of late Aegean style have been found with remains of Dynasty 18, especially in the town of Amenophis IV.—Akhenaten—at Tell el-Amarna; while in the Aegean area itself we have abundant evidence of a great wave of Egyptian influence beginning with this same dynasty To this wave were owed in all probability the Nilotic scenes depicted on the Mycenae daggers, on frescoes of Hagia Triada and Cnossus, on pottery of Zakro, on the shell-relief of Phaestus, etc.; and also many forms and fabrics; *e.g.*, certain Cretan coffins, and the faience industry of Cnossus. These serve to date, Periods III. 1–2 in Crete, the shaft-graves in the Mycenae circle, the Vaphio tomb, etc., to the 16th and 15th centuries B C, and Period III 3, the walls and palaces of Mycenae and Tiryns, the majority of the 6th stratum at Hissarlik, the Ialysus burials, the upper stratum at Phylacope, etc., to the century immediately succeeding.

The *terminus ad quem* is less certain—iron does not begin to be used for weapons in the Aegean till after Period III. 3, and then not exclusively. If we fix its introduction about 1100 B.C. and make it coincident with the incursion of northern tribes, remembered by the classical Greeks as the Dorian Invasion, we must allow that this incursion did not altogether stamp out Aegean civilization, at least in the southern part of its area. But it finally destroyed the Cnossian palace and initiated the "Geometric" age, with which, for convenience at any rate, we may close the history of Aegean civilization proper.

(2) **Annals.**—From these and other data the outlines of primitive history in the Aegean may be sketched thus. A people, agreeing in its prevailing skull-forms with the Mediterranean race of north Africa, was settled in the Aegean islands from a remote Neolithic antiquity, but, except in Crete, where insular security was combined with great natural fertility, remained in a savage and unproductive condition until far into the 4th millennium B.C. In Crete, however, it had long been in close contact with Egypt and had developed a certain civilization, and at a period more or less contemporary with Dynasties 11 and 12 (2200–2000 B.C.) the scattered communities of the centre of the island coalesced into a strong monarchical state, whose capital was at Cnossus. There the king, probably also high priest of the prevailing nature cult, built a great stone palace, and received the tribute of feudatories, of whom, probably, the prince of Phaestus, who commanded the Messará plain, was chief. The Cnossian monarch had maritime relations with Egypt, and presently sent his wares all over the southern Aegean (*e.g.*, to Melos in the earlier Second City period of Phylacope). A system of pictographic writing came into use early in this Palace period, but only a few documents, made of durable material, have survived Pictorial art of a purely indigenous character, whether on ceramic material or plaster, made great strides, and from ceramic forms we may legitimately infer also a high skill in metallurgy. The absence of fortifications at Cnossus, Mallia, and Phaestus suggests that at this time Crete was internally peaceful and externally secure. Small settlements in close relation with the capital, were founded in the east of the island to command fertile districts and assist maritime commerce. Gournia and Palaikastro fulfilled both these ends; Zakro must have had mainly a commercial purpose, as the starting point for the African coast. The acme of this dominion was reached about the end of the 3rd millennium B C., and thereafter there ensued a certain, though not very serious, decline. The period may be considered to close with a general disaster which overtook the principal Cretan sites at the end of the 17th century B C. The cause is still to seek; some think it was due to war, others believe that it may have been the result of a terrible earthquake This would have been caused by the explosion of the volcano of Thera which split that island in two and covered the prehistoric remains which belong to the last phase of the middle period with a deep deposit of pumice.

On the mainland the neolithic population, to judge by its brilliantly painted pottery, seems to have been distinct from that of the islands and to have been related rather to the tribes of the Danubian and Carpathian areas, which some regard as the original home of the Aryans. After the close of the first neolithic period in Thessaly a bronze-using folk, closely akin to the inhabitants of the islands, came to the mainland and advancing from the south-east gradually made themselves masters of the peninsula as far north as Othrys When this occurred we cannot say, but as the earliest bronze age ware on the mainland is still somewhat primitive it may have taken place well before the end of the 3rd millennium B C. Once established the bronze age people, together with the remains of the aborigines, developed on a culture parallel to that of the Cyclades, and several prosperous settlements arise as at Tiryns, Mycenae itself, Asine, Nemea, Zygouries and Korakou. If the Cretans and islanders were of non-Hellenic race, the bronze-using incomers may have introduced the non-Hellenic place-names in *-ssos* and *-nthos*. When the second period in Crete had already evolved about the beginning of the 2nd millennium B.C. a new factor entered the mainland. This was accompained by a new kind of pottery, "Minyan Ware," but whence or how it came we do not yet know. This people seems to have coalesced readily with the pre-existing population which, as we know, already contained two racial elements, and this is reflected in the skull types from Asine. At first, though in communication with islands such as Melos and Paros, they seem to have had no contact with Crete till shortly before the end of the 17th century B.C. Then Aegean culture, as represented by the Cretan culture of the renaissance after the disaster, came into the mainland in full force. This may have been due to a conquest of the mainland by Cretans, or to the hospitable reception of refugees from the disaster in Crete, or to raids conducted by chiefs of the mainland against Crete. Whatever the cause the mainland became saturated with Cretan culture, but it still retained its own individuality, which changed and charged with its own feeling whatever was borrowed [illegible] For instance the evolution of certain mainland vase shapes continues unbroken, but is modified by the influence of Crete. Thus at the beginning of the 3rd period, almost coincident with the rise of the 18th dynasty in Egypt, we have a renaissance in Crete and the establishment of strong centres of culture at Mycenae, Thebes and other mainland sites. In Crete the palaces were rebuilt on a larger scale and with more sumptuous appointments, though there was a distinct tendency towards the baroque. The mainland followed suit, but there is almost the same quality of difference between them as there is between English and American 18th century culture. For two centuries this continued, the mainland becoming stronger and Crete weaker, till just about the time when the 18th dynasty decayed in the nerveless hands of Akhenaten, Crete collapsed and ceased to be the centre of Aegean culture. She still existed, but only as a provincial centre, down to the dawn of the iron age. Her inheritance passed to the mainland which, probably under the leadership of Mycenae, established a great dominion, such as that which Homer depicts under Agamemnon's suzerainty. This is the age of the greatest uniformity of the Aegean culture. Then arose the great Cyclopean fortresses of Tiryns and Mycenae with their palaces, then were built the proudest of the beehive tombs, then Aegean products of mainland style reached distant shores from Sicily to Philistia,

from Macedonia to Egypt. The energy of the mainlanders both in spreading abroad through the Mediterranean the culture which they had adopted as their own and in erecting monumental buildings which testify to amazing architectural skill, demonstrates that they were a people of strong character, capable and original. Were these the Achaeans? Who were the makers of Minyan ware? Were they from Asia Minor like the Tantalids; and were they, so to speak, the forerunners of the Etruscans, who in another land at a later date so quickly absorbed Hellenic culture? These are problems which cannot yet be answered, but it seems possible that Aryans may well have been resident in the peninsula long before the Homeric age and so were not northern invaders as modern criticism has asserted, for Greek tradition regarded the Achaeans as natives. The activities of the mainland folk after 1400 seem to find an echo in the Hittite tablets which record the doings of the Ahhiyava from that century onwards.

Towards the beginning of the 12th century the traditional date for the Trojan War and when Egypt was vexed by the Peoples of the Sea, signs of degeneration again appear and soon after came a final catastrophe, probably about 1100 B.C. Mycenae and Tiryns went up in flames. The palace at Cnossus was once more destroyed, and never rebuilt or re-inhabited. Iron took the place of bronze, and Aegean art, as a living thing, ceased on the Greek mainland and in the Aegean isles, including Crete, together with Aegean writing. In Cyprus, and perhaps on the south-west Anatolian coasts, the cataclysm was less complete, and Aegean art continued to languish, cut off from its fountain-head. Such artistic faculty as survived elsewhere issued in the lifeless geometric style which is reminiscent of the later Aegean, but wholly unworthy of it. Cremation took the place of burial of the dead. This great disaster, which cleared the ground for a further evolution of art, was probably due to an incursion of northern tribes, gradual rather than sudden, who were possessed of superior iron weapons—those tribes which later Greek tradition and Homer knew as the Dorians. They crushed a civilization that had outgrown its strength; and it took two or three centuries for the artistic spirit, instinct in the Aegean area, and probably preserved in suspended animation by the survival of Aegean racial elements, to blossom anew. On this conquest seems to have ensued a long period of unrest and popular movements, known to Greek tradition as the Ionian Migration and the Aeolic and Dorian "colonizations"; and when once more we see the Aegean area clearly, it is dominated by Hellenes, though it has by no means lost all memory of its earlier culture, which was after all the mainspring of the Greek genius. The darkness that shrouds the close of the bronze age was but the prelude to a brighter dawn.

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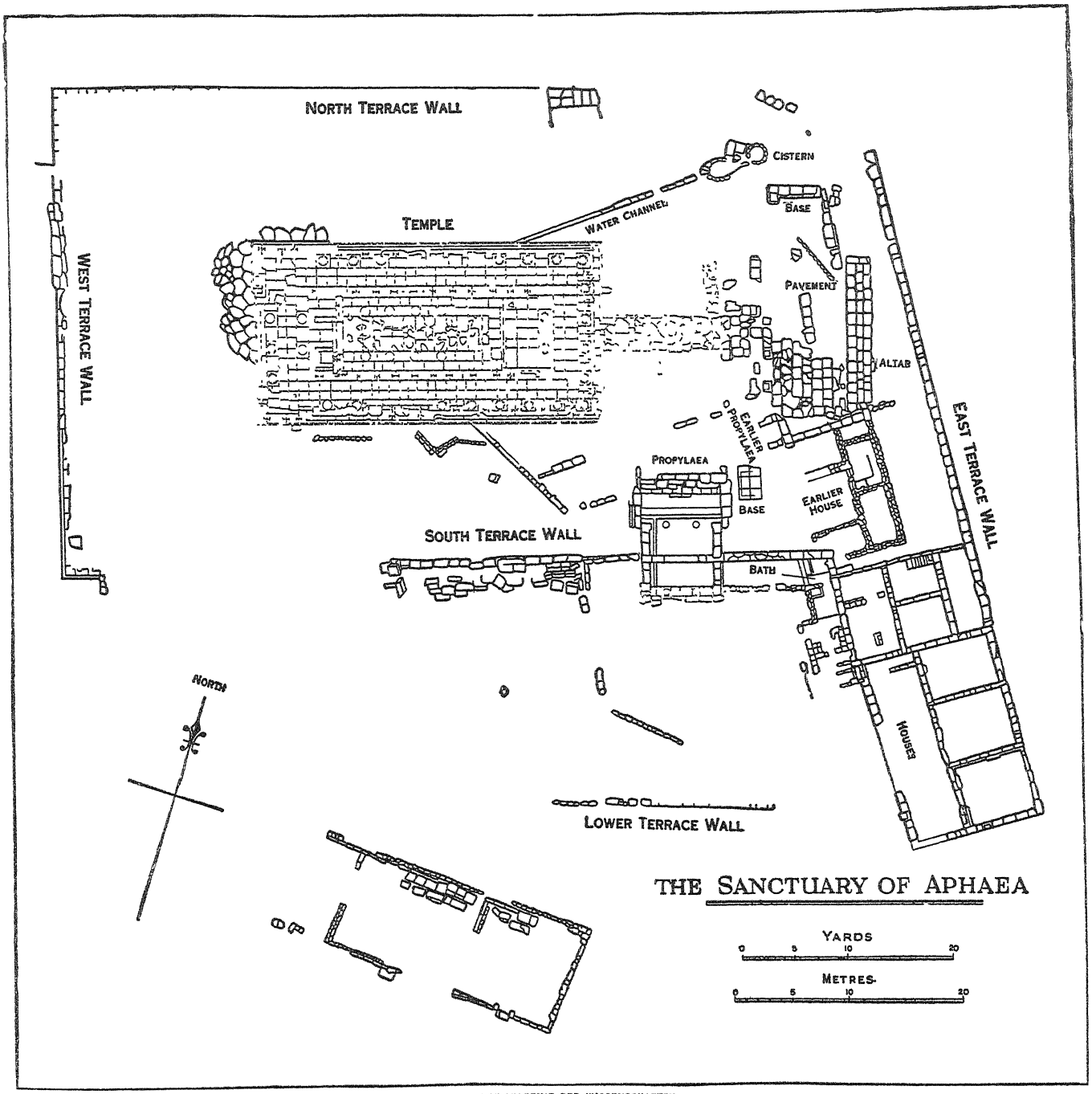
(D G. H , A. J. B W)

**AEGEAN SEA,** an arm of the Mediterranean sea, between Greece on the west and Asia Minor on the east, and connected by the Dardanelles with the sea of Marmora, and the Black sea The name archipelago (*q v*) was formerly applied scientifically to this sea. Various derivations suggest origin of "Aegean" from the town of Aegeae, or from Aegea, queen of the Amazons, who perished in this sea; or from Aegeus, father of Theseus, who drowned himself here. Structurally the sea is a much-shattered old land-block almost entirely submerged, outlined by younger fold-mountains (being continuations of ranges of Asia Minor), also partly submerged. Both features have accounted for this island-studded sea with its alternating deeps and shallows Island chains may be traced through Chios, Psara and Skyros to the North Sporades, through Samos, Nikaria, Mykoni, Tinos, Andros and the south-east promontory of Euboea, and through Rhodes, Scarpanto, Crete and Cerigo to the south-east promontory of the Peloponnese. Between the latter chains are the great group of the Cyclades including Naxos, Paros and Milo. Islands in the northern section of the sea include Thasos, off the Macedonian coast, Samothrace, fronting the Gulf of Saros, and Imbros and Lemnos, in prolongation of the Gallipoli peninsula, while Mitylene lies off the coast of Asia Minor. Important sea basins are those of the Cretan sea with depths of over 1,000 fathoms, and the trough between Thessaly and the gulf of Saros over 600 fathoms Many islands are of volcanic formation; and a well-defined volcanic group includes Milo, Kimolos, Santorin (Thira) and Thirasia. The larger islands have some fertile and well-watered valleys and plains. The chief productions are wheat, wine, oil, mastic, figs, raisins, honey, wax, cotton and silk. The people fish for coral and sponges, as well as for bream and mullet. Greece owns most of the islands, but a number collectively known as the Dodecanese, including Rhodes, Scarpanto, Kaxo, Astypalaea, Kharki, Symi, Tilos, Nisyros, Kos, Kalymnos, Leros and Patmos and minor ones are in Italian hands. Imbros and Tenedos remain Turkish.

**AEGEUS,** son of Pandion and grandson of Cecrops, was king of Athens and the father of Theseus (*q.v.*).

**AEGINA** (*Egina* or *Engia*), a Greek island, in the Saronic gulf, 20m. from the Piraeus. Tradition derives the name from Aegina, the mother of Aeacus, who was born in and ruled the island. In shape Aegina is triangular, 8m. long from north-west to south-east, and 6m. broad, with an area of about 41 sq m The western side consists of stony but fertile plains, well cultivated with grain, vines, almonds, figs and some cotton. The rest of the island is rugged. From the conical Mt. Oros at the south end, the Panhellenian ridge stretches north with narrow fertile valleys on either side. From the absence of marshes the climate is the most healthy in Greece. The island forms part of the modern *nomos* of Attica and Boeotia, of which it forms an *eparchy*. The sponge fisheries are important. The chief town is Aegina, at the north-west end of the island, the favourite summer residence of many Athenians.

**Antiquities.**—The well known temple stands on the ridge near the north corner of the island. In 1811 Baron Haller von Hallerstein and the English architect, C. R. Cockerell, discovered much sculpture from the pediments, which was bought in 1812 by the crown prince Louis of Bavaria and set up in the Glyptothek at Munich. The restoration by B. Thorvaldsen was drastic, ancient parts being cut away to allow of additions treated in imitation of the ancient weathering. The arrangement of the figures has been disputed. Cockerell's inward-facing groups were adopted at Munich till 1901, when Furtwängler's excavation of the site, and fresh




FROM FURTWANGLER, "DAS HEILIGTUM DER APHAIA," BY COURTESY OF THE BAYERISCHE AKADEMIE DER WISSENSCHAFTEN

PLAN OF THE TEMPLE OF APHAEA, IN AEGINA

This temple with its famous sculptures was subjected to violent "restoration" at the beginning of last century, but its true character was established by Herr Furtwängler's researches in 1901. Excavations have also shown that the temple belonged not to Zeus or Athena but to a local goddess Aphaea

study of the figures and fragments in Munich, led to a rearrangement which may be regarded as approaching finality. The figures no longer all face towards the centre, but are broken up, as in other early compositions, into a series of groups of two or three figures each. A figure of Athena still occupies the centre of each pediment, but is set farther forward. On each side of this, in the west pediment, is a group of two combatants over a fallen warrior; in the east pediment, a warrior whose opponent is falling into the arms of a supporting figure; other figures also—the bowmen especially—face towards the angles, and so give more variety. The west pediment, which is more conservative in type, represents the earlier expedition of Heracles and Telamon against Troy; the eastern, which is bolder and more advanced, probably refers to episodes in the Trojan war. There are also remains of a third pediment, which may have been produced in competition, but never placed on the temple (For the character of the sculptures *see* GREEK ART.) Inscriptions found by the recent excavations seem to prove that the shrine belonged not to Zeus or Athena as formerly supposed, but to the local goddess, Aphaea, identified by Pausanias with Britomartis and Dictynna. The present temple probably dates from the time of the Persian wars. In the town of Aegina itself are the remains of another temple, dedicated to Aphrodite; one column of this still remains standing, its foundations are fairly preserved, and its votive offerings are important in the early history of Greek vase painting.

AUTHORITIES.—*Antiquities of Ionia* (London, 1797), ii. Pl. ii.–vii.; C. R. Cockerell, *The Temples of Jupiter Panhellenius at Aegina*, etc. (London, 1860); Ch. Garnier, *Le Temple de Jupiter Panhellénien à Égine* (Paris, 1884); Ad. Furtwängler and others, *Aegina, Heiligtum der Aphaia* (Munich, 1906), where earlier authorities are collected and discussed.

## HISTORY

Aegina, according to Herodotus (v. 83), was a colony of Epidaurus, to which state it was originally subject. The discovery of gold ornaments belonging to the latest period of Mycenaean art suggests the inference that the Mycenaean culture held its own in Aegina for some generations after the Dorian conquest of Argos and Lacedaemon. It is probable that the island was not Dorized before the 9th century B.C. One of the earliest facts known to us in its history is its membership in the League of Calauria, which included, besides Aegina, Athens, the Minyan (Boeotian) Orchomenus, Troezen, Hermione, Nauplia and Prasiae, and was probably an organization for the suppression of piracy. It follows that the maritime importance of the island dates back to pre-Dorian times. Aegina was the first state of European Greece to coin money (*see* PHEIDON). Within 40 years of the invention of coinage by the Lydians (*c.* 700 B.C.), the Aeginetans introduced the system to the western world. The fact that the Aeginetan scale of coins, weights, etc. was in general use in the Greek world is sufficient evidence of the commercial importance of the island. In the earlier half of the 7th century B.C. it appears to have belonged to the Eretrian league. In the next century Aegina is one of the three principal states, and the only state of European Greece trading at the emporium of Naucratis (Herod. ii. 178). At the beginning of the 5th century it seems to have been an entrepôt of the Pontic grain trade, at a later date an Athenian monopoly (Herod. vii. 147). Unlike the other commercial states of the 7th and 6th centuries B.C., Aegina founded no colonies.



FROM PERROT & CHIPIEZ, "HISTORY OF ART," BY PERMISSION OF CHAPMAN & HALL LTD.
THE "HARPY CUP," A FAMOUS EXAMPLE OF AEGINETAN ART. THE ILLUSTRATION SHOWS PART OF THE UPPER DESIGN

The history of Aegina, as it has come down to us, is almost exclusively a history of its relations with Athens. The account which Herodotus (v. 79–80; vi. 49–51, 73, 85–94) gives of the relations between the two states is to the following effect. Thebes, after the defeat by Athens about 507 B.C., appealed to Aegina for assistance. The Aeginetans at first contented themselves with sending the images of the Aeacidae, the tutelary heroes of their island. Subsequently, however, they entered into an alliance, and ravaged the seaboard of Attica. The Athenians were preparing to make reprisals, in spite of the advice of the Delphic oracle that they should desist from attacking Aegina for 30 years, and content themselves meanwhile with dedicating a precinct to Aeacus, when their projects were interrupted by the Spartan intrigues for the restoration of Hippias. In 491 B.C. Aegina was one of the states which gave the symbols of submission ("earth and water") to Persia. Athens at once appealed to Sparta to punish this act of Medism, and Cleomenes I. (*q.v.*), one of the Spartan kings, crossed over to the island, to arrest those who were responsible for it. His attempt was at first unsuccessful; but, after the deposition of Demaratus, he visited the island a second time, accompanied by his new colleague Leotychides, seized ten of the leading citizens and deposited them at Athens as hostages. After the death of Cleomenes and the refusal of the Athenians to restore the hostages to Leotychides, the Aeginetans retaliated by seizing a number of Athenians at a festival at Sunium. Thereupon the Athenians concerted a plot with Nicodromus, the leader of the democratic party in the island, for the betrayal of Aegina. He was to seize the old city, and they were to come to his aid with 70 vessels. The plot failed owing to the late arrival of the Athenian force. An engagement followed in which the Aeginetans were defeated. Subsequently, however, they succeeded in winning a victory over the Athenian fleet. The dates of these incidents are uncertain. It is unlikely that Athens was at war in 498 B.C. as she sent 20 ships to help the Ionians in revolt against Persia, and Herodotus nowhere suggests a peace earlier than 481 B.C. If we may regard the "30 years" of the Delphic oracle as fixed after the event, *i.e.*, after the Athenian victory in 458 B.C. we may assign the dedication of the shrine to Aeacus and the beginning of the war to 488 B.C. This is supported by the building of the great Athenian fleet—"for the war against Aegina"—in 483 B.C. Overtures were unquestionably made by Thebes for an alliance with Aegina, *c.* 507 B.C., but they came to nothing. The refusal of Aegina was veiled under the diplomatic form of "sending the Aeacidae." The real occasion of the outbreak of the war was the refusal of Athens to restore the hostages some 20 years later. There was but one war, and it lasted from 488 to 481 B.C., when it was suspended owing to the invasion of Xerxes. That Athens had the worst of it in this war is certain. Herodotus had no Athenian victories to record after the initial success, and the fact that Themistocles was able to carry his proposal to devote the surplus funds of the state to the building of so large a fleet seems to imply that the Athenians were themselves convinced that a supreme effort was necessary. It may be noted, in confirmation of this view, that the naval supremacy of Aegina is assigned by the ancient writers on chronology to precisely this period, *i.e.*, the years 490–480 B.C. In the repulse of Xerxes it is possible that the Aeginetans played a larger part than is conceded to them by Herodotus The Athenian tradition, which he follows in the main, would naturally seek to obscure their services. The destruction of the Persian fleet appears to have been as much the work of the Aeginetan contingent as of the Athenian. It is difficult to credit the number of the vessels that is assigned to them by Herodotus (30 as against 180 Athenian vessels: *see* GREECE. *History; Bibliography*).

During the next 20 years the philo-laconian policy of Cimon (*q.v.*) secured Aegina, as a member of the Spartan league, from attack. The change in Athenian foreign policy, which was consequent upon the ostracism of Cimon in 461 B.C. led to war, in which the brunt of the fighting fell upon Corinth and Aegina. The latter state was forced to surrender to Athens after a siege, and to accept the position of a subject-ally (*c.* 456 B.C.). The tribute was fixed at 30 talents. By the terms of the Thirty Years' Truce (445 B.C.) Athens covenanted to restore to Aegina her autonomy, but the clause remained a dead letter. In the first winter of the Peloponnesian War (431 B.C.) Athens expelled the Aeginetans, and established a cleruchy in their island. The exiles were settled by Sparta in Thyreatis, on the frontiers of Laconia and Argolis. Even in their new home they were not safe from Athenian rancour. A force landed under Nicias in 424, and put most of them to the sword. At the end of the Peloponnesian War Lysander restored the scattered remnants of the old inhabitants to the island. Its greatness, however, was at an end.

It would be a mistake to attribute the fall of Aegina solely to the development of the Athenian navy. It is probable that the power of Aegina had steadily declined during the 20 years after Salamis, and that it had declined absolutely, as well as relatively to that of Athens. Commerce was the source of Aegina's greatness, and her trade, which appears to have been principally with the Levant, must have suffered seriously from the war with Persia. Her medism in 491 is to be explained by her commercial relations with the Persian Empire. She was forced into patriotism in spite of herself, and the glory won at Salamis was paid for by the loss of her trade and the decay of her marine. The completeness of the ruin of so powerful a state finds an explanation in the economic conditions of the island, the prosperity of which rested upon a basis of slave-labour. It is clear, however, that the number of slaves must have been out of all proportion to that of the free inhabitants In this respect the history of Aegina does but anticipate the history of Greece as a whole.

The constitutional history of Aegina is unusually simple. So long as the island retained its independence the government was an oligarchy There is no trace of the heroic monarchy and no tradition of a *tyrannis* The story of Nicodromus, while it proves the existence of a democratic party, suggests, at the same time, that it could count upon little support.

**Modern.**—Aegina passed with the rest of Greece under the successive dominations of Macedon, the Aetolians, Attalus of Pergamum and Rome In 1537 the island, then a prosperous Venetian colony, was overrun and ruined by the pirate Barbarossa (Khair-ed-Din) One of the last Venetian strongholds in the Levant, it was ceded by the treaty of Passarowitz (1718) to the Turks In 1826–28 the town became for a time the capital of Greece and the centre of a large commercial population which has since diminished considerably.

BIBLIOGRAPHY.—The ancient authorities are Herodotus ii., v., vi., vii. and viii; also Thucydides i. 105, 108, ii 27, iv. 56–7. For a criticism of Herodotus' account of the relations of Athens and Aegina, *see* Wilamowitz, *Aristoteles und Athen*, ii. 280–8, Macan, *Herodotus* iv.–vi; ii. 102–20. *See* also G B. Grundy, *The Great Persian War*, pp. 154 *et seq.*, 202 *et seq*, 373 *et seq.*

**AEGINETA, PAULUS,** a celebrated surgeon of the island of Aegina, whence he derived his name. According to Le Clerc's calculation, he lived in the 4th century of the Christian era; but Abulfaragius (Bar-Hebraeus) places him with more probability in the 7th The title of his most important work is Ἐπιτομῆς Ἰατρικῆς Βιβλία Ἑπτά (*Synopsis of Medicine in Seven Books*); the 6th book, treating of operative surgery, is of interest for surgical history.

The whole work in the original Greek was published at Venice in 1528; another edition appeared at Basle in [illegible] Latin translations have been published, and an English version, with commentary, by F. Adams (1844–48). Edition by Heiberg (Leipzig, 1912) and German trans. with appendix by I. Berendes (Leyden, 1914).

*See* M. Neuberger, *History of Medicine*, vol i (1910).

**AEGIRITE** or **ACMITE:** *see* PYROXENE.

**AEGIS,** in Homer, the shield or buckler of Zeus. It was furnished with tassels and bearing the Gorgon's head in the centre. Originally symbolical of the storm-cloud, it probably signifies rapid, violent motion (Gr. *aïssō*). In the later story Zeus is said to have used the skin of the goat Amaltheia (Gr. *aigis*= goat-skin) as a buckler when he went forth to do battle against the giants; in another legend, it is the skin of a monster slain by Athena, who afterwards wore it as a cuirass. Such skin shields were the original form of body protection, afterwards replaced by the solid shield covered with metal. It appears to have been really the goat's skin used as a belt to support the shield. When so used it would generally be fastened on the right shoulder, and would partially envelop the chest as it passed obliquely round in front and behind to be attached to the shield under the left arm. Hence, by transference, it would be employed to denote at times the shield which it supported, and at other times a cuirass. Hence the aegis appears in works of art sometimes as an animal's skin thrown over the shoulders and arms, sometimes as a cuirass, with a border of snakes corresponding to the tassels of Homer, usually with the Gorgon's head in the centre.



RESTORATION OF A STATUE OF ATHENA, WEARING THE AEGIS, A CUIRASS OF ANIMAL SKIN BORDERED WITH SNAKES AND BEARING THE HEAD OF A GORGON

*See* L. Preller, *Griechische Mythologie*, i. (1887); Pauly-Wissowa's *Realencyklopädie;* Roscher's *Lexikon der Mythologie;* Daremberg and Saglio's *Dictionnaire des Antiquités;* and Smith's *Dictionary of Greek and Roman Antiquities* (3rd ed., 1890).

**AEGISTHUS,** in Greek legend the son of Thyestes by his own daughter Pelopia (Hyginus, *fab.* 88). Having been exposed by his mother, he was found by shepherds and suckled by a goat (αἴξ), whence his name. His uncle Atreus, who had married Pelopia, took him to Mycenae, and brought him up as his own son. For the rest of his story *see* AGAMEMNON; ATREUS.

**AEGOSPOTAMI,** a small creek issuing into the Hellespont, north-east of Sestos, the scene of the decisive battle in 405 B.C. in which Lysander destroyed the last Athenian squadron in the Peloponnesian War (*q v*). The existence of a township is attested by coins of the 5th and 4th centuries.

**AEHRENTHAL, ALOYS LEXA VON,** COUNT (1854–1912), Austro-Hungarian statesman, was born at Gross-Skal, in Bohemia. He was the son of Baron (Freiherr) Johann Lexa von Aehrenthal and his wife Marie, *née* Countess [illegible]stein, and began his diplomatic career in 1877 as attaché to the Paris embassy under Count Beust. He went in 1878 in the same capacity to St. Petersburg, and from 1883 to 1888 he worked at the Foreign Office in Vienna under Kalnoky, with whom he formed close relations. In 1888 he was sent as councillor of embassy to St. Petersburg, where he exercised considerable influence with the ambassador, Count Wolkenstein. Recalled in 1894 to service in the Foreign Office, he undertook important duties, and in the following year went to Bucharest as ambassador. Here he succeeded in strengthening the relations between the courts of Vienna and Bucharest, the secret alliance which King Charles had concluded in 1883 with the Central European Powers being renewed on Sept. 30. In 1899 he became ambassador in St. Petersburg, where he remained until his appointment as Foreign Minister in Oct. 1906. Aehrenthal at this time thought that Austria-Hungary must, even at the cost of some sacrifice, come to an agreement with Russia. In this sense he endeavoured to continue the negotiations successfully begun by his predecessor, Prince Franz Liechtenstein (1853–1938), for bridging over the difference on Balkan questions between Vienna and St. Petersburg, in order to create a basis for a permanent friendly relation between Austria-Hungary and Russia. He played a principal part in concluding the Mürzsteg Agreement of 1903. During the Russo-Japanese War he took a strong line in favour of a benevolent attitude on the part of the Vienna Cabinet towards Russia. When, in Oct. 1906, he succeeded Count Goluchowski as Foreign Minister he at first maintained the views which he had professed as ambassador. He was determined to preserve the interests of Austria-Hungary in the Balkans, but also showed himself prepared to meet the Russian wishes in the Dardanelles question. Accordingly he entered into negotiations, after the outbreak of the Young Turk revolution in the summer of 1908, with Isvolski, arranging with him Sept. 15 at the château of Buchlau, in Moravia, an agreement which aimed at securing for Austria-Hungary the annexation of Bosnia and Hercegovina and for Russia the opening of the Dardanelles to Russian warships.

It was only when Isvolski's proposals were wrecked on the opposition of England, and the Russian minister protested against the annexation of Bosnia and Hercegovina, which had meanwhile been accomplished, and supported the Serbs in their opposition to Austria-Hungary, that Aehrenthal abandoned the idea of a friendly accommodation with the Russian Government. In the sharp struggle during the annexation crisis, not only with Russia and Serbia, but with the Western Powers, he held with tenacious energy to his purpose, and, powerfully supported by Germany, succeeded in carrying out his intentions after excited negotiations which threatened to lead to war. The annexation of Bosnia and Hercegovina was acknowledged by the Powers; an agreement was reached with Turkey; Serbia, after long hesitation, was obliged to submit. For this achievement Aehrenthal was rewarded by his master by elevation to the rank of Count (Aug. 18, 1909), while at the courts of his opponents he was hated but respected.

This was the zenith of his political career. Aehrenthal took the greatest pains to prove in all quarters after the conclusion of the annexation crisis, that Austria-Hungary cherished no far-reaching plans of conquest. In this spirit he offered the most decided opposition to those circles at the court of Vienna which advocated a bloody reckoning with Serbia. He held fast by the Triple Alliance, for he saw in this the surest bulwark of peace.

He sought to form the most intimate relations with the German Empire, but insisted on the independence of the Habsburg Monarchy, and energetically repulsed all efforts on the part of the German chancellery to set limits to that independence. A succession of agreements which he concluded with the Italian Foreign Minister Tittoni, enabled him to maintain correct relations with the Italian Government. Yet, by the maintenance of his peace policy, which had the full approval of the Emperor Francis Joseph, he came into serious conflict with Conrad von Hötzendorf. The battle, carried on with tenacious endurance, ended in 1911 with the victory of Aehrenthal and the resignation of Hötzendorf.

Aehrenthal married in 1902 Pauline, Countess Széchényi. He died Feb. 17, 1912. During his life the estimate of his policy fluctuated violently. On the one hand it was blamed as provocative, on the other as weak. After the disastrous result of the World War, bringing with it the downfall of the Habsburg Monarchy, it is still more difficult to answer the question whether the path pursued by Aehrenthal in foreign affairs was the right one. It is certain that the Entente Powers were drawn more closely together by the active part played, during his period of office, by Austria-Hungary in Balkan affairs. It is true that the chances of success for the Central Powers in an international struggle were better in the years 1909 and 1911 than in 1914. But the question remains undecided whether, if his activity had been longer continued, Aehrenthal would have been able to maintain the position of Austria-Hungary as a great power without an appeal to the decision of arms. There is no doubt that Aehrenthal was a statesman of considerable mark, a man of wide knowledge and well-ordered intelligence; he was ambitious, but not vain, and an untiring worker. Moreover, in moments of great excitement he was able to maintain outward calmness. He was convinced of his own value, but had no desire to parade it. The Emperor Francis Joseph esteemed him, stood by him in the good and evil hours of his administration of foreign affairs, and repeatedly refused to accept his tendered resignation.

*See* B. Molden, *Alois, Graf Aehrenthal: Sechs Jahre auswärtiger Politik Oesterreich-Ungarns* (1917); and the article "Aehrenthal" in the *Deutsche Nekrologen* (vol. xviii., 1917, pp. 230 *seq.*). (A. F. P.)

**AELFRIC,** called the "Grammarian" (*c.* 955–1020), English abbot and author, was educated in the Benedictine monastery at Winchester under Aethelwold, who was bishop there from 963 to 984. Aelfric gained some reputation as a scholar at Winchester, for when, in 987, the abbey of Cernel (Cerne Abbas, Dorsetshire) was finished, he was sent by Bishop Aelfheah (Alphege), Aethelwold's successor, at the request of the chief benefactor of the abbey, the ealdorman Aethelmaer, to teach the Benedictine monks there. He was then in priest's orders. Aethelmaer and his father, Aethelweard, were both enlightened patrons of learning, and became Aelfric's faithful friends.

It was at Cernel, and partly at the desire, it appears, of Aethelweard, that he planned the two series of his English homilies (ed. Benjamin Thorpe, 1844–46, for the Aelfric Society), compiled from the Christian fathers, and dedicated to Sigeric, archbishop of Canterbury (990–94). The Latin preface to the first series enumerates some of Aelfric's authorities, the chief of whom was Gregory the Great. In the preface he regrets that, except for Alfred's translations, Englishmen had no means of learning the true doctrine as expounded by the Latin fathers. The first series of 40 homilies is devoted to plain and direct exposition of the chief events of the Christian year; the second deals more fully with church doctrine and history. Aelfric denied the immaculate birth of the Virgin (*Homilies,* ed. Thorpe, ii. 466), and his teaching on the Eucharist in the *Canons* and in the *Sermo de sacrificio in die pascae* (*ibid.* ii. 262, *et seq.*) was appealed to by the Reformation writers as a proof that the early English church did not hold the doctrine of transubstantiation.

See *A Testimonie of Antiquitie, shewing the auncient fayth in the Church of England touching the sacrament of the body and bloude of the Lord here publikely preached,* printed by John Day (1567). It was quoted in John Foxe's *Actes and Monuments* (ed. 1610).

His Latin *Grammar* and *Glossary* (ed. J. Zupitza in *Sammlung englischer Denkmäler,* vol. i., 1880), were written for his pupils after the two books of homilies. A third series of homilies, the *Lives of the Saints,* dates from 996 to 997. Some of the sermons in the second series had been written in a kind of rhythmical, alliterative prose, and in the *Lives of the Saints* (ed W. W. Skeat, 1881–1900, for the Early English Text Society) the practice is so regular that most of them are arranged as verse by Prof. Skeat. By the wish of Aethelweard he also began a paraphrase (ed by Edward Thwaites as *Heptateuchus,* Oxford, 1698) of parts of the Old Testament, but under protest, for the stories related in it were not, he thought, suitable for simple minds. It has been suggested that this part of his life was chiefly spent at Winchester; but his writings for the patrons of Cernel, and the fact that he wrote in 998 his *Canons* as a pastoral letter for Wulfsige, the Bishop of Sherborne, the diocese in which the abbey was situated, afford presumption of continued residence there. He became, in 1005, the first abbot of Eynsham or Ensham, near Oxford, another foundation of Aethelmaer's. After his elevation he wrote an abridgment for his monks of Aethelwold's *De consuetudine monachorum,* adapted to their rudimentary ideas of monastic life; a letter to Wulfgeat of Ylmandun (*i.e.,* Ilmington on the borders of Warwickshire and Gloucestershire); an introduction to the study of the Old and New Testaments (about 1008, ed. William L'Isle in 1623); a Latin life of his master Aethelwold; a pastoral letter for Wulfstan, archbishop of York and bishop of Worcester, in Latin and English; and an English version of Bede's *De Temporibus. The Colloquium,* a Latin dialogue designed to serve his scholars as a manual of Latin conversation, may date from his life at Cernel. It is safe to assume that the original draft of this, afterwards enlarged by his pupil, Aelfric Bata, was by Aelfric, and represents what his own scholar days were like. The last mention of Aelfric Abbot, probably the grammarian, is in a will dating from about 1020.

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**AELIA CAPITOLINA.** The destruction of Jerusalem and the Temple in A.D. 70 was followed by a second revolt of the Jews. After their defeat Hadrian made the ruined Jerusalem into a Roman colony, Aelia Capitolina, subordinate to Caesarea, the then capital of Palestine (about A.D. 130). Aelia commemorated the emperor's family name; Capitolina is derived from Jupiter Capitolinus to whom a temple was built on the site of the Jewish Temple.

**AELIAN** (AELIANUS TACTICUS), Greek military writer of the 2nd century A.D., resident at Rome. He is sometimes confused with his namesake Claudius Aelianus (*q.v.*). Aelian's military treatise, Τακτικὴ Θεωρία, is dedicated to Hadrian, though this is probably a mistake for Trajan. and the date A.D. 106 has been assigned to it. It is a handbook of Greek, *i.e.* Macedonian, drill and tactics as practised by the Hellenistic successors of Alexander the Great. The author claims to have consulted all the best authorities, the chief of which was a lost treatise on the subject by Polybius. Perhaps the chief value of Aelian's work lies in his critical account of preceding works on the art of war and in the fullness of his technical details in matters of drill. Critics of the 18th century thought Aelian greatly inferior to Arrian, but on

the Byzantines, and on the Arabs, who translated the text for their own use, Aelian exercised a great influence. The emperor Leo VI. incorporated much of Aelian's text in his own work on the military art. The Arabic version of Aelian was made about 1350. The copious details to be found in the treatise made it valuable to the army organizers of the 16th century The Macedonian phalanx of Aelian had many points of resemblance to the solid masses of pikemen and the "squadrons" of cavalry of the Spanish and Dutch systems, and the translations made in the 16th century formed the groundwork of numerous books on drill and tactics. It has been suggested that Aelian was the real author of most of Arrian's *Tactica*, and that the Τακτικὴ Θεωρία is a later revision of this original, but the theory is not generally accepted.

BIBLIOGRAPHY.—First edition of Greek text by Robortelli (Venice, 1552); the Elzevir text (Leyden, 1613) has notes. The text in W. Rüstow and H. Köchly's *Griechische Kriegsschriftsteller* (1855) has a translation, notes and reproductions of the original illustrations.

*See* Baumgärtner's plans in his *Sammlung aller Kriegsschriftsteller der Griechen* (Mannheim and Frankenthal, 1779), reproduced in 1785 as *Von Schlachtordnungen*, trans. Viscount Dillon (1814). *See* also R. Förster, *Studien zu den griechischen Taktikern* (*Hermes*, xii. 1877, pp. 444–49); F. Wustenfeld, *Die Geschichte der Muhammedaner und die arabische Uebersetzung der Taktik des Aelianus* (Gottingen, 1880); M. Jähns, *Geschichte der Kriegswissenschaften*, i. 95–97 (Munich, 1889); Rustow and Köchly, *Geschichte des griechischen Kriegswesens* (1852); A. de Lort-Sérignan, *La Phalange* (1880); P. Serre, *Études sur l'histoire militaire et maritime des Grecs et des Romains* (1887); K. K. Muller, in Pauly-Wissowa, *Realencyklopädie* (Stuttgart, 1894).

**AELIAN** (CLAUDIUS AELIANUS), Roman author and teacher of rhetoric, born at Praeneste, flourished under Septimius Severus and probably outlived Elagabalus (d. 222). He spoke Greek so perfectly that he was called "honey-tongued" (μελίγλωσσος) and wrote in Greek himself. His chief works are: *De natura animalium*, curious stories of animal life, frequently used to convey moral lessons (ed. Schneider, 1784; Jacobs, 1832); *Variae historiae* in 14 books, some of which are fragmentary, consisting mainly of anecdotes of men and customs (ed. Lunemann, 1811). Both works are valuable for the numerous excerpts from older writers. Twenty *Peasants' Letters*, after the manner of Alciphron but inferior, are also attributed to him.

*Editio princeps* of complete works by Gesner (1556); Hercher (1864–66). English translation of the *Various History* only by Fleming (1576), and Stanley (1665) of the *Letters* by Quillard (French) (1895).

**AELRED** (AILRED, ETHELRED) (1109?–1166), English theologian, historical writer, and abbot of Rievaulx, was born at Hexham about the year 1109. In his youth he was at the court of Scotland as an attendant of Henry, son of David I. He renounced the prospect of a bishopric to enter the Cistercian house of Rievaulx in Yorkshire, founded in 1131 by Walter Espec. He was for a brief period abbot of Revesby, Lincolnshire, but in 1146 returned to Rievaulx as abbot. He led a life of the severest asceticism, and was credited with the power of working miracles. In 1164 he went as a missionary to the Picts of Galloway, where he accomplished a great work of pacification. Two years later he died at Rievaulx in the 57th year of his age. In 1191 he was canonized. His writings are voluminous and have never been completely published. Among them is the tract called *Relatio de Standardo*, an account of the Battle of the Standard (1138), better known than the similar account by Richard of Hexham but less trustworthy.

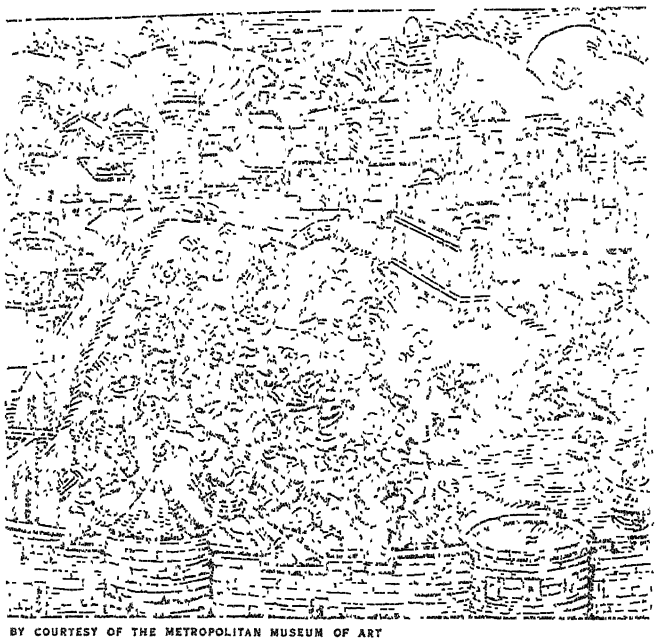
BIBLIOGRAPHY.—*See* the *Vita Alredi* in John Tynemouth's *Nova Legenda Anglie* (ed. C. Horstmann, 1901, vol. i. p. 41), whence it was taken by Capgrave. From Capgrave the work passed into the Bollandist *Acta Sanctorum* (Jan. ii. p. 30). This life is anonymous but of an early date. The most complete printed collection of Aelred's works is in Migne's *Patrologia Latina*, vol. cxcv.; but this does not include the *Miracula Hagulstaldensis Ecclesiae* which are printed in J. Raine's *Priory of Hexham*, vol. i. (Surtees Society, 1864). A complete list of works attributed to Aelred is given in T. Tanner's *Bibliotheca Britannico-Hibernica* (1748), pp. 247–248. The *Relatio de Standardo* has been critically edited by R. Howlett in *Chronicles, etc., of Stephen, Henry II. and Richard I.*, vol. iii. (Rolls Series, 1886).

**AEMILIA, VIA** or **AEMILIAN WAY.** (1) A high road of Italy, constructed in 187 B.C. by the consul M. Aemilius Lepidus, whence its name; it ran from Ariminum to Placentia, a distance of 176m. almost straight N.W., with the plain of the Po (Padus) on the right, and the Apennines on the left. The 79th milestone from Ariminum found in the bed of the Rhenus at Bononia records the restoration of the road by Augustus from Ariminum to the river Trebia in 2 B.C. The bridge by which it crossed the Sillaro was restored by Trajan in A.D. 100. The modern high road follows the ancient line, and has some original and some fine modern bridges After Augustus, the road gave its name to the eighth region of Italy.

(2) A road constructed in 109 B.C. by the censor, M. Aemilius Scaurus, from Vada Volaterrana and Luna to Vada Sabatia and thence over the Apennines to Dertona (Tortona), where it joined the Via Postumia from Genua (Genoa) to Cremona We must, however, suppose that a coast road from Vada Volaterrana to Genua at least existed before the Via Postumia was built in 148 B.C. According to Polybius the Romans had in his time built the coast road from the Rhone to Carthago Nova and it is incredible that the coast road in Italy itself should not have been constructed previously.

**AEMILIUS, PAULUS** (PAOLO EMILIO) (d. 1529), Italian historian, was born at Verona. He obtained such repute in his own country that he was invited to France in the reign of Charles VIII. in order to write in Latin the history of the kings of France, and was presented to a canonry in Notre Dame. He enjoyed the patronage and support of Louis XII. He died at Paris on May 5, 1529. His *De Rebus gestis Francorum* was translated into French in 1581, and has also been translated into Italian and German.

**AENEAS,** son of Anchises and Aphrodite. In Homer, he is represented as a favourite of the gods, who frequently interpose to save him from danger (*Iliad*, v. 311; xx. 308) as he was destined to rule the surviving Trojans after the war. The story of his emigration is post-Homeric, and is set forth in its fullest development by Virgil in the *Aeneid*. Carrying his aged father and household



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A MEDIAEVAL ENAMEL ON COPPER OF ABOUT A.D. 1525–30 SHOWING AENEAS LEADING THE TROJANS IN THEIR STRUGGLE AGAINST THE GREEKS WHO HAVE ENTERED THE CITY IN THE BELLY OF THE WOODEN HORSE. THE ORIGINAL IS IN RICH SUBDUED COLOURS AND GOLD

gods on his back and leading his little son Ascanius by the hand he made his way to the coast, his wife Creusa being lost during the confusion of the flight. After a perilous voyage to Thrace, Delos, Crete and Sicily (where his father died), he was cast up by a storm, sent by Juno, on the African coast.

Refusing to remain with Dido, queen of Carthage, who in despair put an end to her life, he sailed from Africa, and seven years after leaving Troy, reached the mouth of the Tiber. He was hospitably received by Latinus, king of Latium, was betrothed to his daughter Lavinia, and founded a city called Lavinium after her. Turnus, king of the Rutuli, a rejected suitor, took up arms against

him and Latinus, but was defeated and slain by Aeneas on the river Numicius. The story of the *Aeneid* ends with the death of Turnus According to Livy (i. i. 2), Aeneas, after reigning a few years over Latium, was slain by the Rutuli; after the battle, his body could not be found, and he was supposed to have been carried up to heaven He received divine honours, and was worshipped under the name of *Iuppiter Indiges* (Dionysius Halic. i. 64).

*See* Schwegler, *Römische Geschichte* (1867); Roscher's *Lexikon*, s.v.

**Romances.**—The story of Aeneas, as a sequel to the legend of Troy, formed the subject of several epic romances in the middle ages. The *Roman d'Énéas* (*c.* 1160, or later), of uncertain authorship, the first French poem directly imitated from the *Aeneid*, is a fairly close adaptation of the original, but with the characteristic tone of a mediaeval romance. On this work were founded the *Eneide* or *Eneit* (between 1180 and 1190) of Heinrich von Veldeke, written in Flemish and now only extant in a version in the Thuringian dialect, and the *Eneydos*, written by William Caxton in 1490.

See *Énéas*, ed. J. Salverda de Grave (Halle, 1891); also A. Peij, *Essai sur la romans d'Énéas* (1856); A. Duval in *Hist. littéraire de la France*, xix.; Veldeke's *Eneide*, ed Ettmueller (Leipzig, 1852) and O. Behaghel (Heilbronn, 1882); *Eneydos*, ed F. J Furnivall (1890). For Italian versions *see* E. G Parodi in *Studi di filologia romanza* (v. 1887).

**AENEAS SILVIUS:** *see* Pius II.

**AENEAS TACTICUS** (4th century B C), Greek writer According to Aelianus Tacticus and Polybius, he wrote a number of treatises (ὑπομνήματα) on the art of war; the only one extant deals with the defence of fortified cities, and is chiefly valuable as containing a large number of historical illustrations. Aeneas was considered by Casaubon to have been a contemporary of Xenophon and identical with the Arcadian general Aeneas of Stymphalus, whom Xenophon (*Hellenica*, vii. 3) mentions as fighting at the battle of Mantinea (362 B C.).

Editions in I. Casaubon's (1619), Gronovius' (1670) and Ernesti's (1763) eds. of Polybius; also separately, with the notes by J. C. Orelli (Leipzig, 1818). Other texts are those of W. Rüstow and H. Kochly, *Griechische Kriegsschriftsteller*, vol. i. (Leipzig, 1853), and A. Hug, *Prolegomena Critica ad Aeneae . . . editionem* (Zurich univ. 1874), R. Schoene (Leipzig, 1911). *See* L. W. Hunter, *Aeneas on Siegecraft* (revised by S. A. Handford, 1927), an edition with translation and introduction, and the bibliography there given.

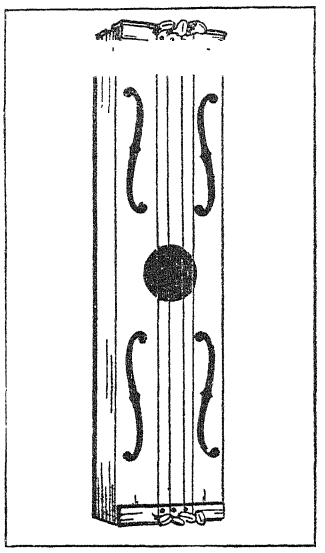
**AENESIDEMUS,** Greek philosopher, was born at Cnossus, in Crete and taught at Alexandria, probably during the 1st century B.C. He was the leader of what is sometimes known as the third sceptical school and revived to a great extent the doctrine of Pyrrho and Timon. His chief work was the *Pyrrhonian Principles* addressed to Lucius Tubero. His philosophy consisted of four main parts: the reasons for scepticism and doubt, the attack on causality and truth, a physical theory and a theory of morality. The reasons for doubt are given in the form of the ten "tropes": (1) different animals manifest different modes of perception; (2) similar differences are seen among individual men; (3) even for the same man, sense-given data are self-contradictory; (4) vary from time to time with physical changes, and (5) according to local relations; (6) and (7) objects are known only indirectly through the medium of air, moisture, etc., and are in a condition of perpetual change in colour, temperature, size and motion; (8) all perceptions are relative and interact one upon another; (9) our impressions become less deep by repetition and custom; and (10) all men are brought up with different beliefs, under different laws and social conditions. Truth varies infinitely under circumstances whose relative weight cannot be accurately gauged There is, therefore, no absolute knowledge, for every man has different perceptions, and groups his data in methods peculiar to himself. In attacking causality he adduces almost entirely those considerations which are the basis of modern scepticism. Cause has no existence apart from the mind which perceives; its validity is ideal. The relation between cause and effect is unthinkable. If the two things are different, they are either simultaneous or in succession. If simultaneous, cause is effect and effect cause. If not, cause must precede effect, and there must be an instant when cause is not effective, that is, is not itself. Thus he arrives at the fundamental principle of scepticism, the universal opposition of causes: παντὶ λόγῳ λόγος ἀντίκειται (*see* Scepticism).

For the immediate successors of Aenesidemus *see* Agrippa

*See* also Carneades and Arcesilaus Of the πυρρώνειοι λόγοι nothing remains; we have, however, an analysis in the *Myriobiblion* of Photius.

Bibliography.—*See* Zeller's *History of Greek Philosophy;* E Saisset, *Aenesideme, Pascal, Kant;* Ritter and Preller, sections 364–370; V. Brochard, *Les Sceptiques Grecs*, with bibliography (1923).

**AEOLIAN HARP,** a stringed musical instrument, played automatically by the wind. It consists of a long narrow sound box made of deal or pine over which ten or a dozen catgut strings of varying thickness are stretched. The sounds are produced by the play of the wind across the strings causing them to vibrate in aliquot parts, *i.e.* (the fundamental note not being heard) the half or octave, the third or interval of the twelfth, the second octave, and the third above it, in fact the upper partials of the strings in regular succession



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A SPECIMEN OF THE AEOLIAN HARP, WHICH WAS PLAYED AUTOMATICALLY BY THE WIND

The principle of the natural vibration of strings by the pressure of the wind was recognized in ancient times. King David, we learn from the Rabbinic records, used to hang his *kinnor* (*kithara*) over his bed at night, when it sounded in the midnight breeze. The same is related of St. Dunstan of Canterbury who was in consequence charged with sorcery. The Chinese at the present day fly kites of various sizes, having strings stretched across apertures in the paper, which produce the effect of an aerial chorus.

**AEOLINE,** the original and more elegant name of the humble instrument familiarly known as the mouth-organ, another name for it being the mouth-harmonica. It was invented in 1829 by Sir Charles Wheatstone, who also invented the concertina, embodying the same principle, and consists simply of free reeds arranged within a small metal box, so that, each reed having a separate air aperture, it is possible by moving the instrument to right and left against the lips, to produce different notes. The mouth-organ may be regarded as a humble relation not only of the concertina (*q.v.*) and the accordion (*q.v.*) but also of the harmonium (*q.v.*).

**AEOLIS** (Aeolia), an ancient district of Asia Minor, colonized at a very early date by Aeolian Greeks. The name was applied to the coast from the river Hermus to the promontory of Lectum, *i.e.*, between Ionia to south and Troas to north. The Aeolians founded twelve cities on the mainland, including Cyme, and numerous towns in Mytilene; they were said also to have settled in the Troad and even within the Hellespont.

**AEOLODION** (also known as Aeoline and Aeolodicon), one of several instruments of the harmonium type, invented and developed during the early part of the 19th century, having steel springs instead of the usual reeds. A closely similar instrument, employing wooden reeds instead of steel, was the aeolsklavier, and yet another was the aeolomelodicon or choraleon, in which the reeds were supplemented by brass tubes. The aeolopantalon in turn was in the nature of a combined harmonium and pianoforte designed so that either the one or the other could be used at will. None of these instruments succeeded in establishing itself.

**AEOLUS** (ī-ŏl-ŏos), in Greek mythology, according to Homer the son of Hippotes, controller of the winds, and ruler of the floating island of Aeolia. In the *Odyssey* (x. 1) he entertains Odysseus, gives him a favourable wind, and a bag in which the unfavourable winds are confined. To see what it contains Odysseus' companions open the bag; the winds escape and drive them back to the island, whence Aeolus dismisses them with

bitter reproaches. He has been identified with Zeus, and his six sons and six daughters with the 12 months According to Virgil, Aeolus dwells on one of the Aeolian islands to the north of Sicily, Lipara or Strongyle (Stromboli), where he keeps the winds imprisoned in a vast cavern (Virgil, *Aen.* i. 52).

**AEON,** or **EON,** a Greek term used to denote an indefinite duration of time; and hence an existence that continues for ever. In the latter sense it was used by the Gnostic sects to denote those eternal beings or manifestations which emanated from the one incomprehensible and ineffable God. (*See* GNOSTICISM.)

**AEPINUS, FRANZ ULRICH THEODOR** (1724–1802), German natural philosopher, was born at Rostock, Saxony, on Dec. 13, 1724. In 1757 he settled in St. Petersburg as member of the imperial academy of sciences and professor of physics, and remained there till his retirement in 1798. The rest of his life was spent at Dorpat, where he died on Aug. 10, 1802 Aepinus is best known by his researches, theoretical and experimental, in electricity and magnetism, and his principal work *Tentamen Theoriae Electricitatis et Magnetismi,* published at St. Petersburg in 1759, was the first systematic attempt to apply mathematical reasoning to these subjects. His discussion of the effects of parallax in the transit of a planet over the sun's disc excited great interest, having appeared (in 1764) between the dates of the two transits of Venus that took place in the 18th century.

**AEPYORNIS,** a genus of large extinct flightless birds, comprising the family Aepyornithidae and the order Aepyornithiformes of the Palaeognathae, they resembled the moas (*q.v.*) in many particulars, and inhabited the southern half of Madagascar up to, possibly, 200 years ago. They are said to have been the origin of the legend of the roc. *Ae. titan* reached a height of 10 ft., and the egg was larger than that of any other bird, measuring more than 13 by 9½ in. and having a capacity of more than 2 gal. (*See* ORNITHOLOGY.)

**AEQUI,** an ancient people of Italy, whose name occurs constantly in Livy's first decade as hostile to Rome in the first three centuries of the city's existence. They occupied the upper reaches of the valleys of the Anio, Tolenus and Himella; the last two being mountain streams [illegible] to join the Nar. They were not finally subdued until the end of the second Samnite War, when they seemed to have received a limited form of franchise. After the Social War the folk of Cliternia and Nersae appear united in a *res publica Aequiculorum* which was a *municipium* (*q.v.*) of the ordinary type. The Latin colonies of Alba Fucens (304 B.C.) and Carsioli (298 B.C.) must have spread the use of Latin (or what passed as such) all over the district; through it lay the chief (and for some time the only) route (via Valeria) to Luceria and the south. At the end of the republican period the Aequi appear, under the name Aequiculi or Aequicoli organized as a *municipium,* the territory of which seems to have comprised the upper part of the valley of the Salto, still known as Cicolano

Of the language spoken by the Aequi before the Roman conquest we have no record; but since the Marsi (*q.v.*) who lived farther east, spoke in the 3rd century B.C. a dialect closely akin to Latin, and since the Hernici (*q.v.*) their neighbours to the south-west, did the same, we have no ground for separating any of these tribes from the Latian group.

*See* the articles MARSI, VOLSCI, and the references there given; R. S. Conway, *The Italic Dialects,* pp. 300 *et seq.* (1897).

**AERARII,** a class of Roman citizens subject to a poll-tax arbitrarily fixed by the censor (from Lat. *aes,* in its subsidiary sense of "poll-tax") They were (1) the inhabitants of conquered towns who possessed the *ius conubii* and *ius commercii,* but no political rights; Caere is said to have been the first example of this (353 B.C.); (2) full citizens subjected to civil degradation (*infamia*) owing to their employment or to conviction for crime; (3) persons branded by the censor. Those who were thus excluded from the tribes and centuries had no vote, were incapable of filling Roman magistracies and could not serve in the army. According to Mommsen, the *aerarii* were originally the non-*assidui* (non-holders of land) The expressions "tribu movere" and "aerarium facere" are explained by A. H. J. Greenidge—the first as relegation from a higher to a lower tribe or total exclusion from the tribes, the second as exclusion from the centuries. Other views of the original *aerarii* are that they were: artisans and freedmen (Niebuhr); inhabitants of towns united with Rome by a *hospitium publicum,* who had become domiciled on Roman territory (Lange); only a class of degraded citizens, including neither the *cives sine suffragio* nor the artisans (Madvig); identical with the *capite censi* of the Serbian constitution (Belot, Greenidge).

BIBLIOGRAPHY.—*See* A. H. J. Greenidge, *Infamia in Roman Law* (1894), where Mommsen's theory is criticized; A. S. Wilkins in Smith's *Dict of Greek and Roman Antiquities* (3rd ed, 1891), J. E. Sandys, *Companion to Latin Studies,* with useful bibliography (1921); W. E. Heitland, *The Roman Republic* (1923).

**AERARIUM,** in ancient Rome the public treasury The treasury contained the moneys and accounts of the State, the standards of the legions, the public laws, the decrees of the senate, etc These were deposited in the temple of Saturn and, during the republic, were in charge of the urban quaestors (*see* QUAESTOR), under the control of the senate. In 28 B.C. Augustus transferred the *aerarium* to two *praefecti aerarii;* in 23 B.C. these were replaced by two praetors (*praetores aerarii* or *ad aerarium*), selected by lot during their term of office In addition to the common treasury, there was a special reserve fund, also in the temple of Saturn, the *aerarium sanctum* (or *sanctius*), originally consisting of the spoils of war, afterwards maintained chiefly by a 5% tax on the value of all manumitted slaves.

This fund was not to be touched except in cases of extreme necessity. Under the emperors the senate continued to have the nominal management of the *aerarium,* while the emperor had a separate exchequer, called *fiscus,* filled largely with the profits from the imperial domains in Egypt and elsewhere. But after a time, as the power of the emperors increased, this distinction virtually ceased. Besides creating the *fiscus,* Augustus also established in A.D. 6 a military treasury (*aerarium militare*), endowed by the emperor himself (see *Monumentum Ancyranum,* iii 35) and supported by the proceeds of the tax on public sales and the succession duty. Its administration was in the hands of three *praefecti aerarii militaris,* senators of praetorian rank

The *tribuni aerarii* have been the subject of much discussion By the *lex Aurelia* (70 B.C.) the list of *iudices* (jurymen) was composed, in addition to senators and equites, of *tribuni aerarii.* Whether these were the successors of the *tribuni aerarii* who in earlier times were paymasters of the troops, etc, or a new order closely connected with the equites, is uncertain. According to Mommsen, they were persons who possessed the equestrian census, but no public horse. They were removed from the list of *iudices* by Caesar, but replaced by Augustus According to Madvig, the original *tribuni aerarii* were not officials but private individuals of considerable means, who undertook certain financial work connected with their own tribes. The term was subsequently extended to include all those who possessed the property qualification that would have entitled them to serve as *tribuni aerarii.*

BIBLIOGRAPHY.—*See* Tacitus, *Annals,* xiii. 29, with Furneaux's notes; J. E. Sandys, *Companion to Latin Studies* (1921), useful bibliography. On the *tribuni aerarii, see* A. H. J. Greenidge, *Legal Procedure* (1901); W. E. Heitland, *The Roman Republic,* §957 (1923).

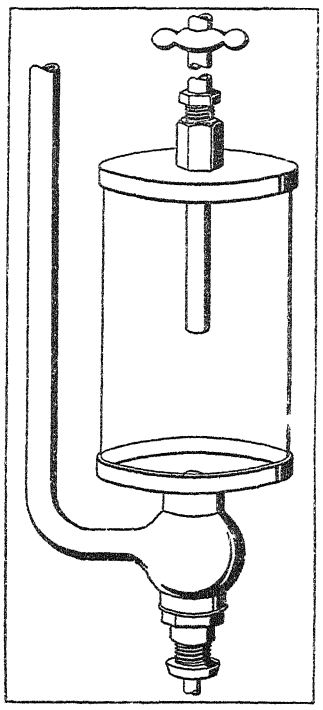
**AERATED BREAD.** Ordinary bread is leavened by yeast, the vesicular texture being imparted by the consequent fermentation, which produces carbonic acid gas. Dr. Dauglish invented a process by which bread is directly charged with carbonic acid gas, and to bread so lightened the name "aerated" is given. Machinery for the purpose was first devised about 1860 In the aerating process, the carbonic acid gas is supplied to the flour in conjunction with the water, and the lightening is thus performed without any decomposition whatever. For this reason it is claimed that aerated bread will agree with persons who find they cannot digest ordinary bread through the fermenting process continuing after the bread is eaten.

The mixing of aerated bread is performed in a hollow air-tight receptacle by the revolution of iron arms fixed upon a central spindle. Aerated water is pumped into the mixing receptacle at a very high pressure, and when the kneading is finished a valve is opened

at the bottom of the mixer and the dough is forced out by the elasticity of its contained carbonic acid gas. As the dough issues from the machine it is cut off in portions of the required weight and goes forward in tins to the oven. The aerated process is much quicker than the ordinary method of breadmaking with yeast, as with the former an hour and a half serves for the entire conversion of a sack of flour into baked loaves, whereas with the latter process four or five hours are occupied in the formation of the dough and a further period of approximately an hour and a half in the moulding and baking.

Perry and Fitzgerald developed a process for mechanically injecting carbon dioxide into a dough while it is being mixed, and claim a patent was issued on March 9, 1885. Their method differs from the Dauglish process in that the gas is injected directly into the mixer while the dough is being mixed. Bailey and Le Clerc, of the U.S. department of agriculture, published a method in which hydrogen peroxide is used as the aerating agent for leavening bread doughs and the like. Carbon dioxide in the compressed state known as "dry ice" has also been recommended as a means of aerating doughs for bread making purposes.

**AERATED WATERS** or **CARBONATED BEVERAGES.** These may be divided into two classes, namely, aerated table waters and effervescent beverages. The latter are flavoured and are known in the United States as carbonated beverages, also as "soda water," "soda" and "pop," and include ginger ales. Natural and synthetic flavours are used. Natural flavours are from fruits, nuts, roots, herbs, bark and leaves of plants. Synthetic flavours are also made in the laboratory.



A DEVICE FOR MEASURING SYRUP INTO AERATED WATER BOTTLES

The syrup enters from the bottom and ceases to flow when it reaches the air tube. The bottle, pressed against bottom nozzle, cuts off the supply tube and opens the discharge valve. The bottle when removed, closes the discharge valve and opens the supply tube and the syrup again enters

Aerated waters are essentially nonalcoholic beverages artificially saturated at the normal temperature with carbon dioxide, the pressure varying according to the type of beverage. Artificially aerated waters had their inception in Priestley's success in 1772 in producing aerated water in imitation of naturally aerated mineral spring water. Large-scale manufacture of aerated water was commenced by Paul at Geneva in 1790 and shortly afterwards by Schweppe in London. In the United States Priestley's experiments interested a Philadelphia physician, Dr. Philip Syng Physick, and he induced a chemist, Townsend Speakman, of the same city, to prepare carbonated water for his patients. Speakman added fruit juice as a flavour and the soft-drink industry in the United States started at that time, 1807. From the original conception of the imitation of natural carbonated water from springs the industry has broadened to include the production of aerated sweetened drinks and substitutes for beverages, such as cider, which are aerated by fermentation. The technique of large-scale aerated-water manufacture and the apparatus employed have undergone very considerable improvement since the beginning of the 20th century. Small-scale production of aerated water has also been rendered much simpler than formerly, when the cumbersome seltzogene apparatus was the only means for small-scale aeration of water.

**Raw Materials.**—Used in the manufacture of aerated waters are water, carbon dioxide, sugar and certain artificial sweeteners, acidifying materials, fruit juices, artificial fruit essences, essential oils, vegetable extracts, mineral salts and foam-producing materials.

The water employed must be unexceptionable as regards purity, both from chemical and bacteriological standpoints. To this end it is customary to filter the water through an effective filtering medium, for example, kieselguhr, unglazed porcelain, filter paper or cloth The water must also be free from objectionable colour, odour and taste. It is sometimes necessary to rectify waters which are either too hard or too soft for the purpose in view, also in some cases manufacturers use distilled water for special purposes

Carbon dioxide is produced as a by-product in the combustion of coke in burning limestone to quicklime, or from sulphuric acid and carbonates, or recovered as a by-product from fermentation processes. It is either made in a special gas generator in the aerated-water factory or is purchased in a highly compressed or liquefied state in steel cylinders. In either case it must be free from objectionable taste.

Dry ice is also used extensively with the aid of special apparatus by which the evolved gas may be led directly to the carbonator. Carbonation furnishes in the finished beverage a gaseous pressure of from 40 to 80 lb. per sq.in depending upon the type of product. High-pressure carbonation is used on ginger ales, and is carried on at about 55° and impregnates the beverages with as high as four and one-half volumes of gas. Low pressure is used on fruit drinks, at about 40° to 42° and as low as one volume of gas may be employed.

### THE SUGAR CONTENT

Sugar is specially manufactured for use in aerated-water production. The best grade canners' cane or beet sugar should be used. High grade dextrose and highly refined corn syrup are also used to some extent. The sugar is highly refined by animal charcoal, no blue material having been employed to produce whiteness. Especial care is taken in the refining process to render the sugar free from sediment or scum when made into syrup. Artificial sweeteners, of which saccharin is the chief, are permitted in some countries, and such sweeteners are employed for special purposes, as in cases where sugar is undesirable because of its tendency towards fermentation, or in periods when sugar is expensive or difficult to obtain. Saccharin may be obtained in very high degrees of sweetening power, for example 550 times the sweetening power of sugar. In the United States the use of saccharin is prohibited by the Federal Food, Drug and Cosmetic act and by the laws of many states.

The acidifying materials commonly used in aerated waters are citric acid, tartaric acid, malic acid, phosphoric acid and lactic acid. These acids should be free from metallic and arsenical contamination. They must be of edible grade.

**Fruit Juices and Fruit Concentrates** used for aerated or carbonated beverages are usually treated to eliminate the albuminous and pectinous matter and finally filtered, so that the finished beverages may be as clear as possible. However, there are also many natural fruit or combination of natural fruit and synthetic flavoured beverages with a cloudy appearance. Concentrated fruit flavours may consist of a blend of fruit juice and fruit oil, *i.e.*, from the peel of citrus fruits, and synthetic fruit esters, or a combination of two or more of these. Essential oils, *e.g.*, lemon, orange, lime, etc., are also employed for flavouring purposes, usually after they have been deprived of their insoluble terpenes and sesquiterpenes by fractional distillation. Vegetable extracts of either aqueous or alcoholic nature are prepared from herbs, roots and seeds for use in the production of ginger and herbal beverages. Mineral salts, *e.g.*, sodium bicarbonate, sodium sulphate, calcium chloride, sodium chloride, etc., are used in the preparation of table waters.

In some countries the use of small quantities of saponin bodies is permitted for the production of foam, such bodies being known as "froth-heading." Other substances which are used for this purpose are liquorice extract, for dark-coloured beverages, and various gums.

Colouring matter is frequently added to aerated beverages. This usually takes the form of burnt sugar or caramel for brown-

coloured drinks, and specially pure coal-tar colours for other beverages.

### BOTTLING METHODS

The apparatus used in aerated-water bottling is of a highly specialized nature. The bottles are washed by machines of various types, some of the larger being capable of cleansing 1,000 dozen bottles per hour. The bottling units are capable of measuring into each bottle the correct amount of syrup, filling with carbonated water, sealing and labelling. The bottles used for aerated-water bottling are of four main varieties: (1) Codd's bottles, in which the bottle is sealed by means of a glass marble held against an india-rubber ring by the gas pressure; (2) crown cork bottles, which are securely sealed by a cork-lined metal cap clamped on to a shallow boss on the top of the bottle mouth; (3) screw-stoppered bottles, in which a lignum-vitae stopper screws down on to an india-rubber ring; and (4) swing lever stoppered bottles, in which a porcelain stopper is held down on an india-rubber seating by a strong wire lever acting upon the bottle neck. In the United States the use of crown cork bottles is almost universal. Aerated beverages are also largely sold in siphons, the gas pressure serving to discharge the container. Aerated waters are very simply produced on a domestic scale, in protected siphons, the aeration being accomplished by means of carbon dioxide contained in small steel cylinders.

**Typical Compositions** of various types of both table waters and sweetened aerated waters vary widely, each manufacturer adjusting his product according to his judgment of popular taste and the type of water he is using. The following examples of dosage for the production of table waters are given, taking soft or distilled water as a basis.

**Soda Water.**—Three and one-half oz. of a mixture of sodium carbonate 15 parts, magnesium chloride 6½ parts, calcium chloride 6½ parts, are dissolved in 10 gal. of water. This is strictly a table water and should not be confused with the term "soda water" used in the United States for flavoured beverages.

**German Table Water.**—Five and one-half oz. of mixture of sodium carbonate 10 parts, sodium chloride 10 parts, sodium sulphate 1 part, magnesium chloride 8 parts, calcium chloride 5 parts, are dissolved in 10 gal. of water.

The dosage employed in the preparation of aerated imitations of natural mineral waters (*see* MINERAL WATERS) is much heavier than in the preparation of table waters, and many salts are included which have well-marked medicinal properties.

The basis of sweetened aerated waters is the syrup, which contains the acidifying material, flavour and colouring matter in addition to the sugar. Usually the syrup contains about 60% of sugar and is employed in the proportion of 1 to 2 oz. for bottles of from 6–12 oz. of finished beverage. The sugar content of carbonated beverages in the United States is from 6–17%, an average of 11%. This is a food value of approximately 80–100 calories for 8 oz. of beverage. The acidity of the syrup is equivalent to from 0.5% to 1.0% citric acid, depending on the flavour used and on the taste desired in the finished beverage. The colouring matter is varied according to the type of fruit which the drink represents. Most essences employed for flavouring aerated beverages are standardized so that they may be used to the extent of 1½–2 oz. per gallon of syrup.

Thus in the preparation of a lime-juice syrup the following essence may be used in the proportion of 2 oz. per gallon of syrup: terpeneless West Indian distilled oil of limes 1 part, alcohol 60° O.P. 28 parts, distilled water 16 parts. In the preparation of beverages of an herbal or root-beer type, a smaller proportion of syrup is employed so that the beverages may not be too sweet.

Also, a small proportion of foam-producing material may be employed.

**Consumption.**—In the United Kingdom, the dominions and other countries where the sale of alcoholic beverages is permitted, consumption of aerated nonalcoholic drinks depends largely on weather conditions and on prices. Taking as example the United Kingdom, the sale of aerated beverages in many years has been restricted by the succession of wet, cold summers and by the high prices of such drinks consequent upon burdens being placed upon the industry by the government.

Only a small proportion of the total production of table waters was exported. As regards the imports of table waters, these were almost wholly of an unsweetened nature, and they amounted to about 8% of the quantity of similar waters produced in the United Kingdom as shown by the reports of the commissioners of customs and excise.

There has been a tremendous increase in the consumption of "soft drinks" in the United States during recent years as a result of increased capacity for production enabled by inventions and improvements of manufacturing equipment, co-operation of the manufacturers through their trade associations with state and federal authorities to prevent the use of inferior ingredients and to promote highest standards of sanitation in manufacturing and marketing, and to extensive advertising.

According to statistics issued by the American Bottlers of Carbonated Beverages, the national trade association of the manufacturers of "soft drinks," the bottled soft drink industry in the United States consisted in 1943 of more than 6,000 plants, with an estimated total investment of $500,000,000 to $600,000,000, employing between 80,000 and 100,000 people, and operating more than 50,000 trucks.

The industry uses more than 250,000 tons of sugar annually, according to a 1943 estimate of the United States department of agriculture, and the association estimates that the annual sales of bottled soft drinks, based on the biennial census of manufactures and other known factors, was for the period 1935–43 as follows.

| *Year* | *Value of Production* | *Year* | *Value of Production* |
|---|---|---|---|
| 1935 | $159,939,553 | 1940 | $411,699,200 |
| 1936 | 211,271,670 | 1941 | 553,834,160 |
| 1937 | 278,616,036 | 1942 | 502,656,000 |
| 1938 | 325,911,074 | 1943 | 444,250,000 |
| 1939 | 361,690,917 | | |

**AERIAL,** an elevated wire or group of wires forming the principal part of a radio antenna of the open or "condenser" type. (*See* ANTENNA.)

**AERIAL LAW** (AIR LAW), the law governing use of the airspace and occurrences therein. Although the air is traversed by a variety of objects, such as projectiles and domesticated birds, capable of creating legal problems, the problems arising out of the growing use of aircraft so overshadow all others that in practical effect air law is the law of aircraft. A strict interpretation might exclude legal problems arising out of the contact of aircraft with the ground, or their presence on the ground; but in common practice the phrase is taken to include such problems as well as those arising during actual flight. Thus the major bodies concerned with the study of air law have given attention to such matters as the conditions of use of airports and the liability of the owners of a wrecked aircraft to its salvagers, as well as to the problems engendered during actual flight.

**Sovereignty.**—The two most fundamental questions of air law are those of national sovereignty in airspace and of private ownership therein. The former, no longer a practical question, had been settled, at least from 1919, by universal recognition that sovereignty in airspace, elsewhere than over the high seas, is held by the sovereign of the underlying territory.

In the early days of air navigation, when pilots of free balloons were unable to control their course but, on the other hand, were not subject to the liability of immediate forced descent as the result of mechanical failure, a considerable body of jurists (mainly of French nationality) maintained an analogy between the upper air and the high seas, both alike being held free of national jurisdiction. The early aeroplanes, however, with their periodic reminders that gravity operated even at the highest levels, and that forced descent held hazards for persons and property on the surface, introduced an element for which the high seas had no analogy. Growing fear of aerial espionage as World War I approached made it increasingly plain that governments would insist

on the prerogatives of national sovereignty in airspace as a condition of national safety. Following that war there was even less likelihood that nations would forego the assertion of sovereign right in the airspace above their territory; and discussions of the public law of the air thereafter invariably proceeded on the assumption that they would not.

**Privileges of International Flight.**—Although sovereignty has thus been long unchallenged, nations may agree among themselves to restrict the exercise of their sovereignty in any way and to any extent that they find advantageous In particular, they are able to concede to one another the right for their aircraft to pass through one another's airspace, subject only to such limitations as they may agree to impose. Provisions of that character appeared in two major international conventions on the navigation of the air drawn after World War I: (1) the convention relating to the regulation of aerial navigation, opened for signature at Paris on Oct. 13, 1919; and (2) the convention on international civil aviation, opened for signature at Chicago on Nov. 1, 1944, which superseded the convention of Paris. The two conventions were alike in granting civil aircraft registered in any contracting country the right of free passage through the airspace of other contracting countries, provided that such aircraft were not engaged in the operation of a regular air transport service. Establishment of such regular services, on the other hand, was possible only through supplementary agreements among the nations concerned. The pertinent provisions of the Chicago convention which was in force among 58 nations at the beginning of 1950 follow:

> Each contracting State agrees that all aircraft of the other contracting States, being aircraft not engaged in scheduled international air services, shall have the right, subject to the observance of the terms of this Convention, to make flights into or in transit non-stop across its territory and to make stops for non-traffic purposes without the necessity of obtaining prior permission, and subject to the right of the State flown over to require landing. (Art. 5)
>
> No scheduled international air service may be operated over or into the territory of a contracting State, except with the special permission or other authorization of that State, and in accordance with the terms of such permission or authorization. (Art. 6)

The Chicago convention of 1944 was more restrictive than its predecessor of 1919 in respect of aircraft engaged in commercial services other than those of scheduled air transportation (*e.g.*, the carriage of cargo by special contract). Under article 5 such operations were made subject to the right of any country in which commercial loads were to be picked up or discharged "to impose such regulations, conditions or limitations as it may consider desirable." During the first years of operation under the Chicago convention this provision was interpreted by numerous nations to require prior permission for any commercial flight of a foreign aircraft into their territory, and thereby substantially to nullify the benefits of the general declaration of right to fly internationally without securing prior permission, insofar as such aircraft were concerned.

The privilege of freedom of aerial transit and landing was extended to scheduled air transport services by a supplementary agreement, the International Air Services Transit agreement, also drafted at the Chicago conference of Nov. 1944. This agreement did not convey any right to engage in commerce within the territories of the participating nations, but the latter did grant to each other's regular air lines the privileges of flying across their territory without landing, and of landing for refuelling or mechanical attention. It was thus possible to establish a regular air service between the United States and Sweden, for example, merely by agreement between those two countries, and to land the aircraft of such a service at intermediate points for refuelling, since Canada, the United Kingdom (for Newfoundland), Iceland and Norway, as well as the United States and Sweden, had signed the agreement. By the end of 1949 the agreement had been accepted by 40 countries; but a number of countries occupying geographical positions of major importance along the world's air routes, such as France, Brazil, China, Ireland and Portugal, still withheld acceptance.

**National Legislation on Air Navigation.**—In virtually every nation, legislation had been adopted by 1948 to define the conditions under which civil aircraft might operate. Such legislation had of course to be in conformity with the terms of any international convention to which the nation was a party, and in many cases was based largely upon the Chicago convention

All such statutes provided for the registration of aircraft and for the verification of their airworthiness; for the licensing of operating personnel; and for the making of appropriate safety regulations In some instances, certain of the rules on these subjects were set out in some detail in the legislation itself; but it had become more usual practice for the legislation to empower the executive to adopt appropriate regulations and amend them from time to time without reference to the legislative body

It became general practice, too, for the national government to establish and operate airports, radio aids to navigation and other facilities for air navigation. In many cases the legislation provided for a measure of economic regulation, or defined the conditions under which private interests might be allowed to engage in air transportation or other commercial activities in the air. Sometimes all these subjects were treated in a single act, but more often they required several pieces of legislation.

The cases of the United Kingdom and the United States may be taken as representative examples. In the United Kingdom the first effective legislation of this character was the Air Navigation act of 1920, drawn to give effect to the terms of the Paris convention of 1919. The supersession of the Paris convention by that of Chicago made new legislation necessary, and the Air Navigation act of 1947 was enacted. The act was a simple one, its principal effect being to permit the executive (*i.e.*, the minister of civil aviation) to issue orders in council for carrying out the Chicago convention and any international standards adopted in accordance therewith, and generally for regulating air navigation. The British act also authorized orders in council to apply customs regulations to the movement of aircraft, to regulate service charges at aerodromes and the conditions of commercial carriage of passengers or goods, and to prohibit the display of any signal or light likely to endanger aircraft. The last point, appearing also in U.S. legislation, was noteworthy as acting, in the interest of the safety of air navigation, to impose obligations or prohibitions upon ground personnel not themselves connected with aeronautics. (For further examples see *The Law of Airports,* below.)

In the United States the introduction of national legislation was complicated by constitutional questions. The first legislation was that of individual states; some of which (Connecticut first) adopted aircraft acts as early as 1914.

The possible extent of the federal government's jurisdiction over civil flight was widely debated in the years immediately following 1918. It came to be generally accepted that interstate operations might be regulated under the interstate commerce clause of the constitution, even though such operations were not explicitly "commercial" in the ordinary sense of the word; and the Air Commerce act of 1926, the first national legislation of the sort, assumed that power. The rules of flight and those affecting aircraft navigation lights and kindred equipment applied under the Air Commerce act to all aircraft operations within the territory of the United States, since a violation of the rules of the air by any aircraft would be an obvious hazard to other aircraft engaged in the interstate operations to which the act directly related. The obligation to prove the airworthiness of aircraft and the competence of the flying personnel and to register the aircraft and secure personnel licences applied under the act only to aircraft and personnel engaged in interstate operations. Those operating within the bounds of a single state were exempt from licensing requirements, except insofar as a number of states adopted legislation to make the holding of federal licences and aircraft registrations a necessary requirement of flight within their territory. Other states set up licensing systems of their own, with a duplication of state and federal authority and of examination and inspection procedure resulting in some cases.

In 1941 the Civil Aeronautics board, to which federal regulatory powers had been transferred from the secretary of commerce,

adopted regulations to require that all aircraft and personnel operating within the United States, even in operations of purely intrastate character, be registered and licensed, on the ground that operation with flight personnel and equipment not meeting fixed and uniform standards would constitute an inherent hazard to interstate operations. Although there was some opposition to that extension of regulatory power, the requirements were upheld (the leading case being *U.S.* v. *Drumm,* U S District court of Nevada, 1944) so that the licensing system became nation-wide. Other federal commonwealths had constitutional difficulties analogous to those in the United States—especially Australia

The Air Commerce act of 1926 was concerned almost exclusively with air navigation, authorizing the secretary of commerce to make safety regulations, grant licences and registrations and install and operate facilities necessary to safe navigation, such as airway lights and radio stations. Airports were expressly excluded from the authorization, since municipalities and private interests were expected to provide them. The Air Commerce act was superseded in 1938 by the Civil Aeronautics act, which created a new tribunal of five members to exercise most of the powers previously assigned to the secretary of commerce and also to preside over a new system of economic regulation of air lines, determining (among other things) on what routes operations should be permitted by U S. lines, what line should serve each route, and what compensation the operator should receive from the government for carrying the mail. In 1940 a further change was made and the administrative functions under the act were returned to the department of commerce, but air navigation regulations continued to be adopted by the five-man Civil Aeronautics board.

**Private Ownership in Airspace.**—In the case of private ownership, the trend was opposite to that in national sovereignty. It was toward freedom of flight, rather than away from it.

The traditional rule, as cited by Sir William Blackstone but recognized long before his time, was that the ownership of the surface of the land conveyed rights extending indefinitely upward and downward, and in particular included all the airspace above the surface property. (For more detailed discussion, *see* Carl Zollmann, *Law of the Air* [1927]; Harold L. Brown, *Aircraft and the Law* [1933].) The right of real-property owners to make unlimited use of the airspace above their property, with only a few exceptions (see *The Law of Airports,* below) remained valid, but courts were virtually unanimous in holding that ownership conveys no right to forbid, or to receive compensation for, the passage of aircraft through that part of the airspace of which the owner is currently making no effective use. He might erect a tower 1,000 ft. high on his property, if he so desired (subject to zoning regulations) but if the actual structures that he erects are of no more than ordinary building heights, he cannot successfully claim trespass by aircraft which pass over his property, even though at an altitude much less than 1,000 ft. To make his claim good, the property owner must show the area of his actual use to have been invaded.

A decision by the U.S. supreme court (*Causby* v. *United States,* 1946) reads explicitly on this subject, as follows: "It is ancient doctrine that at common law ownership of the land extended to the periphery of the universe—*Cujus est solum ejus est usque ad coelum.* But that doctrine has no place in the modern world. The air is a public highway, as congress has declared. Were that not true, every transcontinental flight would subject the operator to countless trespass suits Common sense revolts at the idea. To recognize such private claims to the airspace would clog these highways, seriously interfere with their control and development in the public interest, and transfer into private ownership that to which only the public has a just claim."

In considering whether there has been actual damage to the property holder, indeed, the rights of ownership are irrelevant. Claims have been successfully pressed on grounds of nuisance, of jeopardy to frightened livestock, etc., even when the aircraft alleged to have made the trouble clearly had not passed above the complainant's premises. The reality of nuisance or material damage has been the test.

**The Law of Airports.**—Actions for aerial annoyance come most frequently from people domiciled near airports where aeroplanes pass constantly along the same course and necessarily at comparatively low altitudes. In a number of cases courts have enjoined the establishment or the continued operation of airports where a strong showing of injury to the neighbours was made. The British Air Navigation act of 1949 met the resultant hazard to airport operation by a provision that no action should lie in respect of nuisance by reason of the noise and vibration caused by aircraft on any aerodrome on which the terms of any order in council regulating such matters had been complied with The aerodrome management complying with the government's direction thus became immune from legal attack.

The property owner may seek to restrict the airport, but the airport may also restrict the adjacent property owner through appropriate legislation or regulation to prevent his use of his property in a fashion which would handicap or create hazards for air navigation Numerous cities in the United States have adopted zoning regulations prohibiting the erection of structures of more than a limited height in the neighbourhood of airports—the allowed height usually decreasing as the ends of the airport runways are more nearly approached. Such zoning must of course not be so extreme in character as to work serious hardship on landowners. Where it would do so, as for example if safety of flight required that the structures on a given piece of land be only a few feet in height or even that there be no construction at all, compensation would have to be paid The acquisition of the owner's rights in the airspace above his property, compensating him for a surrender in perpetuity of the right to occupancy above a stated level, is a possibility where such extreme restrictions are necessary; but airport zoning ordinarily imposes only moderate restrictions, and entails no compensation.

In most countries aerodromes are nationally licensed, and unlicensed places can be used for the landing and taking off of aircraft only under restrictive conditions, if at all. In the United States no such licensing exists, and any attempt to establish it might encounter constitutional difficulties on the ground that an airport is purely an intrastate activity, exempt from national regulation. The federal government's potential powers over airports derive from the attachment of appropriate conditions to the grant of national aid from which most airports have benefited, and from the power to make flight regulations prohibiting aeroplanes from landing and taking off at airports not possessing suitable characteristics. The latter power, however, has been but little used. (For an extensive discussion of the legal problems engendered by airports, *see* Charles S. Rhyne, *Airports and Courts* [1944].)

**Private Air Law.**—Private air law relates in general to the commercial relationship existing between the operators of aircraft and other persons. It is distinguished from public air law as represented in the Chicago convention; but the distinction cannot always be drawn with precision. It includes questions of liability for damage, the legal status of mortgages on aircraft, the special legal problems arising out of the insurance of aircraft and their occupants, etc. The extreme mobility of aircraft and the frequency with which they cross international boundaries made it particularly necessary that such matters be the subject of international agreement, to guard against conflict of jurisdiction, escape from obligation by transfer of property across a national boundary, or inequitable variations of practice from one point along a flight path to another. It would be manifestly inequitable, for example, if the amount recoverable by the heirs of the victim of an air transport accident were to be largely dependent upon the particular national territory within which the accident occurred.

Such subjects were for 20 years the care of the Technical Committee of Experts on Air Law (usually known as C.I.T.E.J.A., from the initials of the organization's French name) established on May 17, 1926, and absorbed into the International Civil Aviation organization in 1947. The members of C.I.T.E.J.A. did the preparatory work on the development of private law conventions, which were then formally considered for adoption

and opened to signature at international conferences on private air law. Conferences were held at Paris in 1925 (where C.I.T.E.J.A was initiated), at Warsaw in 1929, at Rome in 1933, and at Brussels in 1938. The most important accomplishment resulted from the second conference, and became commonly known as the Warsaw convention. Its primary purpose was to define the liability of air lines to passengers and shippers in case of disaster. It was widely accepted in Europe and to some extent elsewhere, although the 37 countries which had ratified the convention by Jan 1, 1950 (excluding countries which no longer existed), included only 2 of the 20 Latin American nations The limits of liability established by the convention were (at the dollar value of gold current in 1950) $8,290 for each passenger and $7 50 per pound for cargo. These figures were low as judged by the domestic practice of some nations, notably the United States, but high by the standards of others. Much preparatory work was being done in 1946–50 on the revision of the convention.

The conference at Rome in 1933 produced two conventions, the more significant of which governed the conditions and amount of liability of the operator of an aircraft for damage caused to parties on the ground It set a maximum operators' liability for a single accident at approximately $7.50 per pound of gross weight of the aircraft causing the damage, but with the further provision that the total liability could not in any case exceed $133,000, whatever the size of the aircraft. To secure the benefits of these limits the convention provided that an aircraft operator must maintain a continuous guarantee of his readiness to meet claims, either by having insurance or by keeping a bond posted The limits set may appear low; but it is obviously impossible for the operator of an aircraft to be bound to pay the full extent of any damage that an accident might cause to property on the surface. A single aircraft overtaken by disaster might cause a fire or explosion resulting in millions of dollars of damage. Even though limits were placed several times as high as those of the Rome convention, it would still be necessary for property owners wishing security to the full extent of possible damage to carry their own insurance against the results of an air disaster.

The Rome convention complemented that of Warsaw. Taken together, they defined substantially the total liability of an aircraft operator.

Another convention prepared at the conference in Rome dealt with the precautionary attachment of aircraft to ensure the satisfaction of claims against the owner, and exempted aircraft used in commercial transportation from such attachment.

Neither of the two Rome conventions had any extensive acceptance by the beginning of 1950. That on liability for damage on the ground had been ratified by only 5 countries, including Belgium and Brazil alone among the major operators of air transportation; and that on precautionary attachment by only 13. A revision of the convention on liability for damage on the ground was being actively developed in I.C.A.O.'s legal committee.

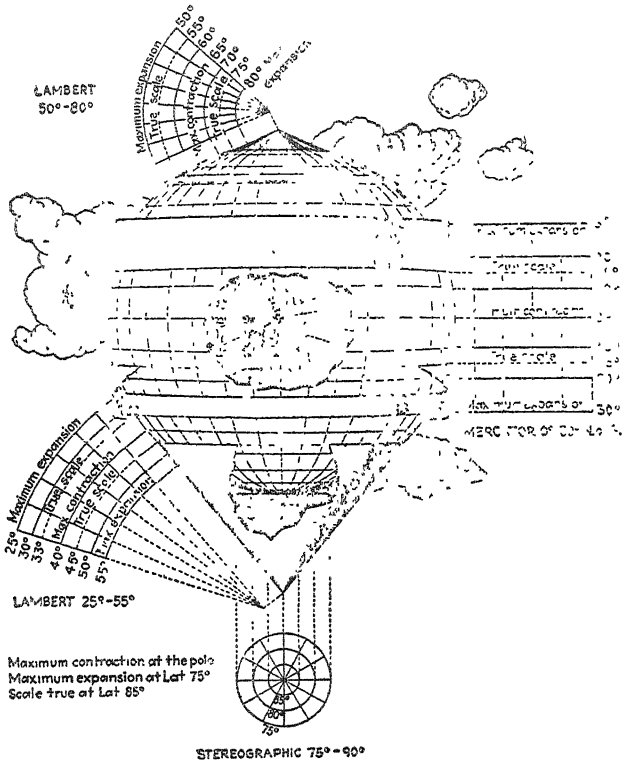
The conference at Brussels in 1938 produced a convention on the legal consequences of assistance and salvage of aircraft (or by aircraft) at sea. It fixed the maximum indemnity payable by operators of shipwrecked aircraft to rescuing vessels or aircraft at a maximum of approximately $3,300 per person saved, or not in excess of $33,000 in any instance. Supplementary provisions allowed additional indemnity for the saving of valuable property. Through 1949, the Brussels convention had not been ratified by any nation.

At the end of 1947 the work of developing such conventions had been transferred to the International Civil Aviation organization (I.C.A.O ). The 1948 assembly of I.C.A.O. adopted a convention on the registration of liens and mortgages on aircraft, to safeguard the mortgagee and thus make it easier to place such mortgages. Up to the summer of 1950, only the United States and Mexico had ratified the new convention.

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**AERIAL NAVIGATION.** Aerial navigation is the science which deals with the methods used to direct an aircraft in flight from one place to another, to determine its position while en route and to predict its time of arrival at some specified point on the route.

The study of air navigation is usually classified into four general methods: (1) pilotage; (2) dead reckoning; (3) radio navigation; and (4) celestial navigation.




FROM P. V. H. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG. 1.—ILLUSTRATION OF AERONAUTICAL CHART PROJECTIONS

**Pilotage.**—Pilotage is the method of directing aircraft from place to place by referring to visible landmarks on the earth's surface, such as church spires, lighthouses, beacons, railroads, rivers, mountains and lakes. In normal flight over land, with a suitable map and good visibility, the pilot guides his plane much as a tourist directs his automobile from a road map, by simple piloting, which is nothing more nor less than comparing objects observed from the plane with objects shown on the map.

*Aids to Night Pilotage.*—Types of aeronautical lights that are widely used in night pilotage or conditions of low visibility are:

1. Beacon lights, which mark major airways and airports. They consist of a searchlight which throws a beam of white light elevated several degrees above the horizontal and rotates six times per minute. Many of these beacons have auxiliary coloured lights which are used for identification or directional purposes. A green auxiliary light indicates the proximity of a lighted airport.

2. Approach lights, which are used as landing aids to pilots after the completion of instrument approaches. They are of several types and are arranged in several configurations. In general, they extend out from the end of the "instrument" runway and are of high intensity, so as to give the pilot a visual reference to the ground after the radio signals have led him down through the overcast to an altitude of from 200 to 500 ft.

*Maps and Charts.*—A map or chart is a representation of the earth's surface or a part of it on a flat piece of paper. An accurate chart is probably more important than any other item of equipment. If the destination is not in sight at the start, the navigator's first act is to look at the map to find the direction in which he must go to reach the desired destination. In the course of the flight, as the navigator fixes his position by any or all of the various methods, he plots his fix or determined position on

the chart and checks the direction from this fix to the destination

Aeronautical charts have been designed and published in several series for use in contact flight, where pilotage is the primary method of navigation. Local charts on a scale of 1:250,000 were published for congested areas around important terminals. Sectional charts were published for the entire United States and for many foreign areas on a scale of 1:500,000, and came into general use for pilotage. By international agreement a world series of uniform charts on a scale of 1:1,000,000 was planned for pilotage on flights of aircraft with moderate to high air speeds.

*Chart Projections*—The spherical surface of the earth obviously cannot be represented on a flat piece of paper without some distortion of certain features. In an ideal chart, distances, bearings, shapes and areas would be shown in their true relation, and the shortest distance between two points would be represented by a straight line. It is possible to preserve one of these properties by sacrificing some of the others, and maps are constructed by various methods of projection in order to preserve that feature which will be most useful for the particular purpose the map is to serve.

The principal projections used for aviation charts are the Mercator and Lambert conformal projections. The gnomonic projection is used to determine the great circle (shortest) route between distant terminals, and the stereographic projection is in general use for navigation in polar areas.

The stereographic chart is formed by projecting the earth's surface on a plane with the observer 180° away from the point of tangency of the plane. The stereographic chart is indicated for the south polar area with observer standing at the north pole (*see* fig. 1).

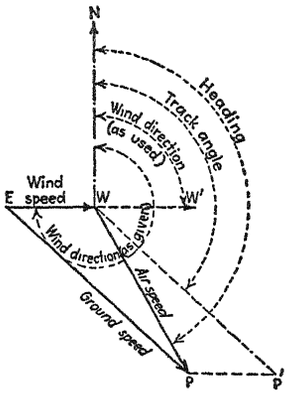
**Theory of Dead Reckoning.**—Dead reckoning is the method of determining a position by keeping an account, or reckoning, of the course and distance run from a previously known position called the point of departure.

Dead reckoning requires a knowledge of the direction and the speed of flight. In still air (*i.e.*, in the absence of wind) direction is obtained from the compass reading; the speed is read from the air speed indicator, and the navigator's task is simple. Generally, however, the position of an aircraft on the surface of the earth is the resultant of two distinct motions: the motion of the plane in the direction in which it is headed because of the driving power of the engine; and the motion of the air ocean itself relative to the earth, which is commonly referred to as the wind.

Hence, the navigator needs to keep an estimate of the velocity and direction of the wind at the height at which he is flying and to compute his dead reckoning position accordingly.

*Triangle of Velocities.*—The speed and direction of an aeroplane flying through the air, which itself is moving bodily in some direction, are given by the triangle of velocities.

Any velocity may be represented by a straight line with an arrow, by making the direction as shown by the arrow represent the direction of the motion, and by making the length of the line proportional to the speed. The resultant of two simultaneous velocities can then be found by starting from any point and drawing a line so that its length and direction represent one of the velocities, and from the end of this line drawing another line to represent the second velocity; the resultant velocity is found by closing the triangle in the reverse direction.




FROM P. V. H. WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG. 2—TRIANGLE OF VELOCITIES SHOWING DEAD-RECKONING TERMS. THE ANGLE NWP IS THE HEADING; ANGLE NWP', THE TRACK; ANGLE NWW', THE WIND DIRECTION; ANGLE PWP', THE DRIFT ANGLE; LINE WP, THE AIR SPEED, LINE EP OR WP', THE GROUND SPEED; LINE EW OR PP', THE WIND SPEED

In fig. 2 let the line E→W represent a wind of 30 m.p.h. from the west; and let the line W→P represent the heading and air speed of an aeroplane flying southeast through the air at 70 m.p.h. These two velocities form two sides of the triangle EWP, starting from E to W for the wind direction and speed and going from W to P for the heading and air speed. The motion resulting from the combination of these two velocities can be represented by the line E→P, which closes the triangle in the reverse direction; in other words, E→P represents the track and ground speed. This triangle of velocities is of the utmost importance in all problems of dead reckoning, and it must be thoroughly understood.

In the chosen lettering: E = earth, W = wind, P = plane

For example, E→P indicates the speed and direction of the plane relative to the earth—in other words, the plane's track and ground speed; W→P represents the speed and direction of the plane relative to the air, which is the heading and air speed.

**Radio Navigation.**—Radio can be used in various ways as an aid to navigation. The more common of these navigational aids at mid-20th century were: (1) radio direction finders; (2) radio beacons; (3) low-frequency radio range stations; (4) radio location markers; (5) omnirange stations; (6) distance measuring equipment; (7) loran; (8) consol; (9) radar; and (10) instrument approach systems.

A *radio direction finder* is a radio receiver which uses a rotatable loop antenna. Since a loop antenna has directional characteristics, the direction of a transmitting station can be determined by observing the position of the loop when the minimum strength of signal is received. Radio direction finders may be installed at land stations or aboard ships and aircraft.

A *radio beacon* is a radio transmitting station which transmits a specified signal at regular intervals for use by radio direction-finding equipment.

A *low-frequency radio range station* is an installation consisting of two radio transmitters, one of which sends the letter "A" (. –) and the other sends the letter "N" (– .). The signals are keyed automatically and so timed that the sequence is interlocking; that is, the dot of the letter "A" fills the interval between the dash and dot of the letter "N," and the dash of the letter "A" fills the interval after the dot of the letter "N." The transmitted signals are controlled in such a manner that in four directions about the station the signal intensities are equal, which results in the reception of a steady tone. This is known as the "on-course" signal This signal is received in a sector about 3° in width and is commonly known as a radio beam.

*Radio location markers* are very-high-frequency radio transmitters located at radio range stations and on radio beams as position markers. The signals are transmitted in a narrow vertical pattern, and the markers on radio beams transmit a coded signal to provide identification of the beam. Their purpose is to provide pilots and navigators with positive check points on the airways and on the approaches to air terminals.

The *omnirange* is a very-high-frequency radio station that transmits a variable phase signal in all directions. With special receivers, a pilot can fly straight toward or away from this range on any of about 120 range legs, each about 3° in width. The low-frequency radio range system in the U.S. was being replaced by omniranges at mid-century.

*Distance measuring equipment* was developed for use in conjunction with omniranges. It is air-borne, and indicates to the pilot his distance in miles from an omnirange station where the DME transmitter also is located. In tests this equipment measured distances up to 100 mi. with an accuracy of about 98%.

*Loran* is a long-range navigational aid which was developed during World War II. Its accuracy compares favourably with that of celestial navigation, and its effective range for aircraft over water is about 700 nautical mi. by day and 1,400 nautical mi. by night.

The loran system consists of pairs of ground transmitters, an air-borne receiver-indicator, and specially prepared charts or tables for determining lines of position.

The pairs of loran transmitters are arranged in chains around the world, located primarily to cover heavily travelled ocean routes and coastal waters. Each pair consists of a master station

that transmits a pulsed signal which, after a fixed delay, triggers a slave station on exactly the same frequency.

The fundamental principles of loran are as follows: (1) pulsed radio signals are broadcast from a pair of transmitting stations in accurately known positions; (2) these signals are received visually on a specially designed receiver and one signal is superimposed on the other; (3) the difference in the time of arrival of these signals is measured on the indicator component of the receiver; (4) this measured time difference is used to locate the line of position of the observer on the loran chart; (5) the intersection of the lines of position obtained from two pairs of loran transmitters will give a loran fix and determine the position of the observer.

*Consol.*—Consol is the British name for an improved long-range radio navigational aid developed in Germany during World War II and known as Sonne.

In this system a specially designed transmitting station radiates a series of 60 dots and dashes that are interrupted by an equisignal which is directional to a fraction of a degree, except for two sectors of about 40° each, which are in line with the station antennae towers. These signals can be received with an ordinary low-frequency receiver.

By counting the dots and dashes heard on each side of the equisignal during a complete cycle of transmission, and referring this count to a chart with an overprint of consol lines or to consol tables, 12 lines of bearing will be indicated. The correct bearing can be obtained by applying the dead reckoning position or by taking a rough bearing with a direction finder.

Each station transmits an identifying signal and a steady signal for use by direction finding equipment as a part of each cycle. The time required to complete a cycle was originally two minutes; but the British station at Bushmills, North Ireland, was modified so that it could complete a cycle in 40 sec.

*Radar* (*q.v.*) was installed extensively in military aircraft and to a limited extent in commercial aircraft as a method of identifying landmarks at night and when flying in or above clouds. Radar also indicates the distance of an identified object from the observer. Its useful range, however, is limited to the line of sight distance.

Radar beacons were established at many points throughout the world at mid-century. These beacons operated only in conjunction with specially designed radar sets, and by their use the bearing and distance of the observer from the position of the beacon could be obtained.

*Instrument Approach Systems.*—In the United States the Civil Aeronautics administration developed a system for landing approaches under instrument conditions, commonly known as ILS (instrument landing system). It consists of: (1) a localizer radio beam for guidance to the airport runway; (2) a glide path radio beam for guidance in correct descent; and (3) fan markers to fix position along the approach path.

During World War II another system was developed for instrument approaches. This system used a talk-down technique and became commonly known as GCA (ground controlled approach). Its principle was based on following the path of an aircraft on ground radar equipment; by means of radio communication the pilot is given information regarding his position relative to the desired glide path and is issued instructions for letdown procedures.

**Celestial Navigation.**—Celestial navigation is the method by which an observer's position on the earth is determined by means of calculations based upon celestial observations. The equipment required consists of a sextant for observing the altitude of celestial bodies, an accurate timepiece, a current air almanac and a set of tables for reducing the observations of time and altitude as required.

*Theory of Celestial Navigation.*—An observer at any point on the earth's surface, except the poles, sees the altitude of any heavenly body change with time. The altitude can be calculated for any instant of time by methods described below.

The altitude of a heavenly body also changes with a change in the position of the observer. The amount of this change depends on the direction in which the observer moves relative to the geographical position (G.P.) of the observed body. If he moves one mile directly toward the observed body, the altitude is increased by one minute; while if he moves in any other direction, the altitude is changed by a predictable amount.

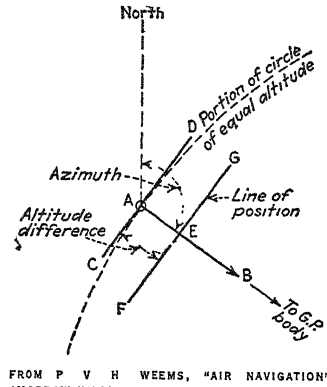
The converse is also true; namely, if the altitude of a heavenly body is known, the distance from the geographical position of the body for the instant of observation is known. Celestial navigation is based on the application of this principle. Therefore, we may say that the work of the navigator in celestial navigation consists in finding his geographical co-ordinates of latitude and longitude by locating himself with reference to the geographical position of one or more celestial bodies.

The exact position of a body, in terms of declination and Greenwich hour angle, may be taken from the almanac for any instant of time, and this position may be plotted on a globe or chart as latitude and longitude. A circle with this position as centre, and with a radius equal to the observer's distance from this position as determined by the sextant (*i.e.*, 90° altitude), would be the observer's circle of position; the observer must lie somewhere on this circle called "circle of equal altitude." If two bodies were observed, the intersections of the circles of position would determine the position (or two possible positions) of the observer.

Since the circle of position as determined above would be very large, a small arc of the circle may be considered as a straight line, at some point on which is the observer's position If it were possible to lay off on a chart with sufficient accuracy the distance of the observer from the geographical position of the body, celestial navigation would be easy. The observer would doubtless use a sextant graduated to read zenith distance (instead of altitude) in minutes, or nautical miles, and this distance would simply be used as the radius of an arc to be laid off on a chart from the plotted position of the body. Unfortunately, the great distances—up to 5,400 mi.—to be plotted make this simple and obvious method impracticable, but the desired effect is secured by the means about to be described.

*The Line of Position.*—It is not usual to include the whole earth on any one chart; only that part of immediate interest to the navigator is shown. Hence, the whole circumference of circles of equal altitude would not appear; since the radius of the circle is usually large, the small, slightly curved arc in which the navigator is interested may be replaced by a straight line without appreciable error. This line is called a line of position, or position line, or Sumner line after Capt. Thomas H. Sumner, a U.S. shipmaster, who discovered it in 1837.

*Plotting a Position Line on a Chart.*—To lay down a line of position on a chart by the method of Marcq St. Hilaire, it is necessary to take the dead reckoning position, or some convenient point close to it, and to compute for this assumed position the altitude and azimuth of the observed body at the time at which the observation was made. If the altitude observed with the sextant agrees exactly with the computed altitude, the altitude difference is zero. Then it is necessary only to draw from the assumed position A (fig. 3) a line of bearing AB along the computed azimuth of the body and a line CAD at right angles to this; then CAD is the required line of position.




FROM P V H WEEMS, "AIR NAVIGATION" (MCGRAW-HILL)

FIG 3.—PLOTTING ALTITUDE DIFFERENCE AND LINE OF POSITION

If, however, the observed altitude is greater than the computed altitude, say by 15 min. which equals 15 nautical mi. on the earth's surface, the observer is nearer to the geographical position of the heavenly body than the assumed dead reckoning position would indicate. In this case, the position line must be moved closer to the geographical position of the heavenly body by the amount of the altitude difference. Hence, the intercept AE is

*Airport Size Planning Standards*

| [illegible] | Class 1 | Class 2 | Class 3 | Class 4 |
|---|---|---|---|---|
| Length* of landing strips (in feet) | 1,800 to 2,700 | 2,700 to 3,700 | 3,700 to 4,700 | 4,700 and more |
| Width of usable landing strips (in feet) | 300 | 500 | 500 | 500 |
| Length of runways (in feet) | None | 2,700 to 3,700 | 3,700 to 4,700 | 4,700 and more |
| Width of runways (in feet) | None | 150 (Night operations)<br>100 (Day operations only) | 200 (Instrument)<br>150 (Night operations)<br>100 (Day operations only) | 200 (Instrument)<br>150 (Night operations)<br>100 (Day operations only) |
| Number† of landing strips and runways determined by percentage of winds, including calms, covered by landing strip and runway alignment | 75% | 80% | 90% | 95% |
| Facilities | Drainage<br>Fencing<br>Marking<br>Wind-direction indicator | Drainage<br>Fencing<br>Marking<br>Wind-direction indicator<br>Lighting<br>Hangar and shop<br>[illegible]<br>Office space | Drainage<br>[illegible]<br>Hangar and shop<br>Fuelling<br>Weather bureau<br>[illegible] building<br>[illegible] control<br>[illegible] approach system, when required | [illegible]<br>Lighting<br>Hangar and shop<br>Fuelling<br>Weather bureau<br>Administration building<br>[illegible]<br>Visual traffic control<br>Instrument approach system, when required |

*All of the above landing-strip and runway lengths are based on sea-level conditions; for higher altitudes increases are necessary One surfaced runway is recommended for the effective length of each landing strip for airports in classes 2, 3, and 4.
†Landing strips and runways should be sufficient in number to permit take-offs and landings to be made within 22½° of the true wind direction for the percentage shown above [illegible] per hour and higher, based on at least a ten-year weather bureau wind record where possible [illegible] wind conditions of three miles per hour and lower.

administration classifies airports in the United States with the length of the longest runway or landing area, at sea level, as the major consideration, as follows:

| Class | Runway length |
|---|---|
| Sub 1 | Less than 1,800 ft. |
| 1 | 1,800–2,700 |
| 2 | 2,700–3,700 |
| 3 | 3,700–4,700 |
| 4 | 4,700–5,700 |
| 5 | 5,700–6,700 |
| 6 | 6,700–7,700 |
| 7 | 7,700–8,700 |
| 8 | 8,700–9,700 |
| 9 | 9,700 and up |

These lengths should be increased by 7% for each 1,000 ft. of elevation above sea level and further increased by 5% for each degree that the mean temperature of the hottest month of the year, averaged over a period of years, exceeds the standard temperature.

Broken down by class the total of 6,484 airports in the United States on Jan. 1, 1950, was as follows:

| Class | Airports |
|---|---|
| Sub 1 and 1 | 4,100 |
| 2 | 1,027 |
| 3 | 576 |
| 4 | 447 |
| 5 | 185 |
| 6 and up | 149 |

All runway lengths referred to in the classifications below and set forth in the accompanying table apply to airports located at sea level. For those appreciably above sea level, the minimum length of landing strip for each class must be increased enough to compensate for the decrease of density with altitudes. Thus, an airport 6,000 ft. above sea level needs in general a runway length almost 50% greater than would be needed for a field of the same class near to sea level.

*Class 1 Airport.*—Small communities having a population up to 5,000 which are not located either on the present or proposed air-carrier system should provide airports which can safely accommodate aircraft of the small private-owner type. It is recommended that under sea-level conditions the airport should be equipped with landing strips having a minimum length of 1,800 ft. to 2,700 ft. together with "clear approaches." (For additional data *see* the table.)

*Class 2 Airport.*—In larger communities having a general population range of from 5,000 to 25,000, located on present or proposed feeder lines where considerable aeronautical activity is present, the airport should safely accommodate the larger-sized, private-owner-type planes and small-sized transport planes For such airports it is recommended that under sea-level conditions they provide landing strips of at least 2,700 ft. to 3,700 ft. in length, together with "clear approaches." (For additional data *see* the table.)

*Class 3 Airport.*—Important cities having a general population range of from 25,000 to several hundred thousand, located on feeder lines or serving as intermediate points on main-line routes, should provide airports which can safely accommodate the present-day transport planes. To do this such airports under sea-level conditions should provide landing strips 3,700 ft. to 4,700 ft. in length together with clear and unobstructed approaches. (For additional data *see* the table.)

*Class 4 Airport.*—Cities representing the major industrial centres of the nation and serving as the most important junction points or terminals on the airway system should provide airports which can safely accommodate the largest aircraft in use and those planned for the immediate future. Such airports under sea-level conditions should provide landing strips 4,700 ft. and more, together with clear approaches. (For additional data *see* the table.)

The Civil Aeronautics administration estimated in Sept. 1945 that a total of $1,027,159,417 had been expended on civil airports through July 1, 1945. Of this total, $740,705,171 was in federal funds, $10,155,266 in state funds, $192,950,000 in municipal funds and $83,348,980 in commercial and private funds.

On May 13, 1946, the congress of the United States passed the Federal Airport act, which authorized the expenditure of $500,000,000 in federal funds over a seven-year period for the construction and improvement of airports in the United States and its possessions. The act designated the Civil Aeronautics administration to administer the provisions of the bill (public law 377). The act specified that federal funds would be appropriated on a yearly basis for seven years and would not exceed $100,000,000 in any one year, and that federal funds would be matched by subunits of government-sponsoring projects.

As of Feb. 1, 1950, local and state project sponsors at 726 locations had received grants of $98,100,000 in federal funds and had matched those funds with their own money.

**Planning an Airport.**—The first step and one of primary importance in planning an airport is the determination of the type and extent of activities the airport ultimately will serve, even though only partial development is to be undertaken initially. Anticipated future expansion of facilities and activities based on available data and estimates should be included in the original planning. In this respect acquisition of sufficient land to allow for orderly expansion and development is of vital

importance. Other considerations to be taken into account in the planning stage are the estimated number of passengers and cargo transport movements that may be expected at ultimate development, the number and type of aircraft likely to be based at the field, the extent of training activities and the volume of business resulting from sales and service at the proposed airport

To obtain a correlation between the design of airports and the design of aircraft to be used in air-carrier operations the Civil Aeronautics administration developed technical standard order-N6A, which as amended on Oct. 4, 1948, has the purpose of: (1) guiding employees of the CAA regarding approvals and recommendations for runway design; (2) indicating to sponsors of airport development projects the runway characteristics to which federal funds will be applied; and (3) indicating to manufacturers and operators of transport-type aeroplanes the airport runways that will be available

The standards outlined in TSO-N6A for air-carrier service are as follows:

| Service | Runway (feet) | | Taxiway (feet) | Landing Strip (feet) | Pavement Loading (per wheel in pounds) | |
|---|---|---|---|---|---|---|
| | Length | Width | Width | Width | Single wheel | Dual wheel |
| Feeder . . . | 3,500 | 100 | 40 | 300 | 15,000 | 20,000 |
| Trunk line . . . | 4,200 | 150 | 50 | 400 | 30,000 | 40,000 |
| Express . . . | 5,000 | 150 | 60 | 500 | 45,000 | 60,000 |
| Continental . | 5,900 | 150 | 75 | 500 | 60,000 | 80,000 |
| Intercontinental | 7,000 | 200 | 75 | 500 | 75,000 | 100,000 |
| Intercontinental express . | 8,400 | 200 | 100 | 500 | 100,000 | 125,000 |

The types of service in TSO-N6A are defined in the following manner:

Feeder: Airports for feeder-type service.
Trunk line Airports to serve on air-line trunk routes
Express: Airports at large cities or important junction points on trunk routes.
Continental Airports serving long nonstop continental flights.
Intercontinental Airports serving [illegible] or transoceanic flights.
Intercontinental express: Airports serving transoceanic flights of largest types of aircraft.

**Locating the Airport.**—The selection of a site for an airport is of tremendous importance and an extremely difficult task resulting from the variety of vital factors that must be considered. In most instances the final selection of a site is determined by compromise after a consideration of all elements On one hand an airport must be conveniently located to the community it is to serve since airports are almost entirely dependent on public use for financial success. Important considerations here are public transportation and travel distance. On the other hand the physical features of the terrain under consideration are of great importance with regard to construction costs and the safe operation of the airport when it has been developed. In general, an elevated location is best suited for the location of an airport because of fewer obstructions along the approaches to the field, better natural drainage, less fog and more uniform winds. Valley sites have the advantage of requiring less grading and are most easily accessible to ground transportation and public utilities

**Airport Approach Protection.**—Obstructions in the approach zones of an airport may restrict its use to certain types of operations and in some cases cause abandonment of an otherwise well-designed airport. To avoid such situations airport sites should be so selected that the approaches to the runways are free from obstructions such as power lines, smokestacks, tall buildings or radio towers. Before final selection the practicability of removing or reducing all obstructions to a safe height should be assured.

The following horizontal and vertical approach standards are recommended for obstruction clearance:

50-to-1 for runways to be used in instrument approaches.
40-to-1 for other runways to be used for scheduled air-carrier operations or by similar aircraft in nonscheduled operations
20-to-1 for all runways or landing strips to be used exclusively by smaller aircraft

For example, if an obstruction is 10 ft. high 700 ft. from the end of the runway, it would fall beneath the normal minimum flight path of an aircraft taking off or making a landing.

**Wind Data.**—Wind direction is a vital factor in the selection of an airport site and the layout of the runways since aircraft take off and land into the wind. Determination of the direction of prevailing winds is made by an analysis of weather reports in the area covering at least ten years.

Runways should be oriented so that aircraft may be landed at least 95% of the time with cross winds not exceeding 15 m.p.h. Usually, 95% wind coverage with cross-wind components not exceeding 15 m.p.h will provide 98% to 100% coverage with less than 30 m.p.h. cross-wind components. Since almost all airports will serve light aircraft as well as transport types the wind data should be analyzed on the basis of the 15-mi. cross-wind component.

**Drainage and Soil.**—One of the most important considerations governing the location and selection of an airport site is the nature and composition of the soil and subsoil upon which it is to be built. For the economical development of the area for aviation purposes, and especially for the life and durability of paved runways, taxi strips and aprons detailed knowledge of the soil at the site, and especially [illegible] in contact with water, is vitally important.

Adequate drainage is especially essential to the proper maintenance of paved runways, for experience shows that more runway paving failures occur from unstable subsoil conditions caused by lack of proper drainage than for any other reason.

**Grading.**—In view of the fact that one of the few permanent features involved in the construction of an airport is the grading, a complete grading plan of the entire area ultimately to be included in the airport should be prepared, which will take into consideration the contemplated finished grades Since excessive grades, particularly, make night landings more difficult, longitudinal and transverse landing areas in runway grades not to exceed 1½% are preferable on major airports. Obviously, however, it is not always feasible to adhere to this figure as a maximum, since wide topographical variations on a site often involve excessive quantities of earth movement. From the standpoint of aircraft operations alone, however, field grades should be held as close to 1½% as possible.

**Airport Surfaces.**—In sections of the country where the soil and climatic conditions permit the growth and maintenance of firm turf surfaces, it may be possible for airports with light and limited traffic to maintain continuous operations throughout all seasons of the year without resorting to artificial surfacing. However, under the strain of heavy traffic, turf is likely to become rutted, especially if exposed to alternate freezing and thawing.

*Paved Runways*—The term "runway paving" is applied to the process of preparing a firm, stable, all-year, all-weather runway surface, free from dust or aggregate which may be blown or picked up by aircraft engine propellers, and designed to support the static and dynamic loads occurring in the landing and taking off of aircraft.

Hard surfacing may be divided roughly into two general types: rigid and flexible. Rigid-type pavement include portland-cement concrete of varying dimensions, with or without steel reinforcing, and certain asphaltic concretes and asphaltic or water-bound macadams which may approach rigid characteristics. Flexible paving includes virtually all of the bituminous types of construction with cutbacks, emulsions, planed or blade mixes, built-up penetrations and bituminous soil stabilization.

Rough nonskid wearing surfaces are avoided because of the excessive tire wear which such surfaces impose on landing aircraft. The preferable finishes for concrete surfaces are those approaching a smooth trowelled finish

Lighting.—Airports vary so widely that each airport will

present a separate problem. The size and shape of an airport, the terrain, the amount of traffic, the types of aircraft to be used and the nature of the soil or runway surface all will play important parts in affecting the number, type and extent of the lights which should be used. The following types of lights are, however, considered standard equipment on all major air terminals in the U.S :

*Airport Beacon.*—This is a double-ended light projector emitting two lights, one green and one white, from opposite ends. This light rotates at six revolutions per minute and tells the pilot there is a lighted field available. Beacons are generally mounted on towers set either on the ground or on top of airport buildings. In any case, the beacon should be mounted at least 20 ft. above any buildings or surrounding structures.

*Illuminated Wind-Direction Indicator.*—Two basic types of illuminated wind-direction indicators are in general use: the illuminated wind cone and the illuminated wind tee Their primary function is to give the true direction of the wind at all times. They should also be readily visible at all times to aircraft approaching from any direction

*Runway Lights*—Runway lights are used on major air terminals to assist pilots in effecting landings and take-offs They consist of white lights slightly elevated from the ground along the runways, spaced 200 ft apart along each side of the runway. Their installation is always arranged in pairs opposite one another on both sides of the runway. They are controlled so that only one runway at a time may be illuminated.

On instrument runways the lights on the last 1,500 ft. of the runway are half yellow and half white so that they show yellow when viewed from the approach end of the runway. This marks a yellow caution zone warning the pilot he has left only 1,500 ft. of runway on which to come to a stop or to pull up and make another approach.

Across the ends of the runways are placed green threshold lights which define the ends of the runways.

*Approach Lights.*—Approach lights are lights located outside the landable area and arranged to indicate a favourable or preferred direction of approach. The principal use of approach lights is to mark a lead-in or approach lane for instrument landing.

*Obstruction Lights.*—Obstruction lights clearly mark with red lights all obstructions surrounding an airport. High obstructions like radio towers which extend more than 70 ft. above their surroundings are marked by lights at the top and at the one-third and two-third levels.

*Air Marking.*—The air marker is one of the simplest and least expensive aids to air navigation in common use in the United States, but it is, at the same time, most effective and necessary, particularly in so far as the private or itinerant flyer is concerned. Perhaps the chief hazard concerned in "contact flying" is the danger of becoming lost because of poor visibility or other reasons and it is obvious that this hazard is considerably lessened if the flyer can ascertain his exact whereabouts and orient himself by merely looking down as he passes over a town or city and reading a sign giving this information. Since this is the chief function of air marking, the markers should be of a letter size 10 to 20 ft., and legible under good visibility conditions from a height of at least 3,000 ft. Such markers are either painted or constructed on roofs, on the ground or painted directly on highways.

**Seaplane Bases.**—The word airport has been used for convenience to describe bases for land planes alone. Airports less narrowly defined and seaplane bases should, however, be considered together since they provide essentially the same purpose. The limiting dimensions of a landing area for seaplanes are customarily determined by natural conditions. Open-sea take-offs are usually dangerous and frequently impossible and the greatest possible length of operating area is usually fixed by the width or depth of a harbour except where the whole body of water (lake, river, sound or bay) is so protected as not to become very rough. In an ideal seaplane base adequate rules governing the use of channels and the mooring of craft would leave several straight runways of adequate length clear of any fixed obstructions or any great congestion of water traffic

**Major Air Terminals.**—While there are a number of major air terminals scattered throughout the United States, only one has been selected to illustrate the development and growth and the requirements which must be met by a modern major air terminal.

Washington National airport, Washington, D.C. is the only federally owned and operated airport in the United States, being under the jurisdiction of the Civil Aeronautics administration Approximately 4 mi. S of Washington on a bend of the Potomac river, the airport is modern in every detail. All the latest safety devices for air navigation may be found there The terminal building is streamlined for efficient handling of passengers, cargo, mail and freight Construction work started on the field on Dec 1, 1938, and the field was dedicated on June 14, 1941 The field covers 730 ac., of which 450 ac. comprise the landing area

Washington National airport has four asphalt-paved runways as follows.

| | | | |
|---|---|---|---|
| North–South | 6,855 ft | long by 200 ft | wide |
| North–West | 5,210 ft | long by 200 ft | wide |
| North–East | 4,895 ft | long by 150 ft | wide |
| East–West | 4,100 ft. | long by 150 ft | wide |

All the runways have unobstructed approaches Of the eight approaches to the field, six are over water while only two are over land. The Potomac river bounds the field on three sides.

The airport was raised out of a series of mud flats along the Potomac river by the corps of engineers, U.S. army. In the construction of the landing area from the mud flats 19,500,000 cu yd. of material were pumped from the river bottom to fill and reclaim 325 ac. from the marshes.

The design of the terminal building follows Southern Colonial lines in keeping with the architecture and landscaping of the nation's capital The terminal building has 111,000 sq ft. of space and houses besides the CAA administrative offices, the control tower, restaurants, barbershops and other concessions and also air line offices and ticket counters. The main lobby, glass enclosed on the runway side, is flanked by two promenade decks for use by visitors and sight-seeing parties. Twelve large hangars flank the administration building to serve the nine air lines serving the field In the rear of the administration building is the parking area capable of handling 5,000 cars.

The control tower, atop the administration building, houses the latest in radio and radar equipment. For landings under bad weather conditions the pilot has a choice of two devices to be guided down through the overcast. In many instances the pilot using one system is monitored for greater safety by the other system. There is the instrument landing system, based on radio principles, which allows the pilot to fly down an invisible path by watching a needle on his instrument panel. Precision beam radar or ground controlled approach, using radar principles, is also used; the pilot is "talked down" by personnel on the ground who watch the progress of the aircraft on the radar scanning screen Surveillance radar in use at the field enables tower personnel to see and locate all aircraft within a 30-mi. radius of the airport as an aid to the proper separation of traffic. The field has the most modern of runway and approach lights.

The net direct bookkeeping cost of the airport was $9,889,043. Four government agencies took part in the planning and construction. Actual construction was done by the U.S. army engineers while the Civil Aeronautics administration, Public Buildings administration and Public Roads administration were involved in the planning The Works Progress administration and the Public Works administration also participated but no charges were made for the services of these agencies since they involved relief labour.

**Airports in Europe.**—It is the general rule in Europe that the major airports serving international air traffic are financed and operated by the central government. This is true, however, to a lesser degree in Great Britain, where the trend follows that of the United States in providing municipally owned and operated

airports.

Detailed information on all types of airports in Europe was sketchy after World War II; however, most countries have followed the prewar trend in providing large and well-made terminals for international travel

In Great Britain alone there were 25 airports of entry as of Jan. 1, 1950, while Germany had 9; Italy, 8; France, 9; and Belgium, 6

London airport, located 12 mi. W. of Westminster bridge, boasts a 9,000-ft runway along with one 6,000 ft. and one 5,700 ft., all having a 300-ft. width. Modern in every respect, the London airport has instrument landing system and ground controlled approach for instrument weather operations, high intensity approach and runway lights, a weather station and control tower. Airports at Bovington, Blackbushe, Hurn, Prestwick and the royal air force Valley and Manston fields also serve London as alternates in bad weather.

In Germany, Tempelhof field, Berlin, partially destroyed during World War II, was again in 1950 in commercial operation, serving not only the military but scheduled air lines. The longest paved runway at Tempelhof is 5,300 ft. Tempelhof serves as an airport of entry for Germany along with Gatow field, Berlin, Bremen, Cologne, Düsseldorf, Rheim Main at Frankfort, Hamburg, Munich and Stuttgart.

Paris is served by two fields, Le Bourget and Orly, both operating as airports of entry. Orly has three concrete runways, the longest being 6,630 ft. by 197 ft. Le Bourget also has three concrete runways, the longest being 6,900 ft. in length by 197 ft. in width (Ho. Bm.)

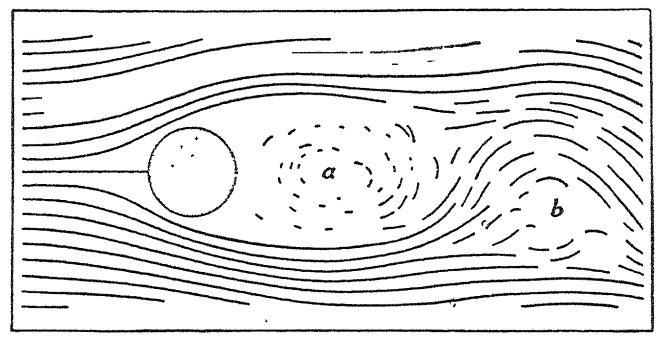
**AERODYNAMICS.** The word aerodynamics is applied both to the study of the disturbances generated in air by the passage of solid bodies, such as aircraft, and to the study of the motion of free aircraft under the influence of air reactions. The former is a specialized development of *fluid dynamics* and the latter of *rigid dynamics, i.e.,* the dynamics of rigid bodies under the action of external forces. (*See* DYNAMICS and HYDRODYNAMICS)

The equations of motion of a slightly viscous fluid such as air can be formulated, but have not in general been solved, and in no instance has the complete motion of the air passing a body, such as a wing, been calculated directly from the laws of motion. Aeronautics is thus dependent for its data mainly upon direct experiment, and since quantitative experiments upon the full scale are difficult and costly, the bulk of the data available has been obtained upon small models of the parts concerned suspended in artificially induced currents of air. The technique of the measurement of air reactions upon models suspended in "wind tunnels," (*see* AERONAUTICS) as the tunnels containing these air currents are called, has reached a high development and many tunnels of great size and power have been built in all countries seriously concerned with aeronautics. The largest wind tunnel in the world is at Langley Field, Virginia; it has a cross section of 30 feet by 60 feet and is operated by two fans 35 feet 5 inches in diameter, driven by a 4,000 horse power slip-ring induction motor. The tunnel can accommodate a moderate sized aeroplane, one, for example, that would carry two or three passengers. New tunnels in England and Germany approach the size of the one at Langley Field.

It is clearly of importance to determine how nearly similar is the manner in which the air flows around such models to the manner in which it flows around the corresponding full scale aeroplane. In many aeronautical problems air can be treated as though it were an incompressible and inviscid fluid. In these cases it can be shown that *similar bodies moving in a similar manner will generate similar air flows,* no matter what the size of the body, the density of the fluid, or the speed of the motion Even the nature of the fluid, whether liquid or gas, is of no consequence, and experiments intended to relate to air may equally well be carried out in water, or in any other fluid which, for the purpose in hand, can be treated as incompressible and inviscid. The simple laws of aeronautics, such as that the pressure varies in proportion to the density of the air and to the square of the speed, are based upon this assumption.

**Effects of Compressibility and Viscosity.**—In aeronautics air can generally be treated as though it were incompressible, unless velocities exceeding some 300 or 400 miles per hour are involved When velocities higher than this occur, compressions and expansions of the air as it passes the solid body may seriously influence the flow, the rule for similarity of flow becomes less simple. It is then necessary that corresponding velocities in the motions to be compared should all bear the same ratio to the velocity of sound in the fluid in which the motion takes place. For example, if high speed experiments in air and water are to be strictly comparable, the experiments in water must be carried out at speeds four times as great as the corresponding speeds in air, because sound travels some four times as fast in water as in air, but when both the model and the full scale body move through air the actual speed of the model must be the same as that of the full scale body Such high speeds as 300 to 400 miles per hour are not yet commonly met in aeronautics, except in racing aeroplanes and at the tips of the blades of high speed airscrews, and hence it is unnecessary to obey this law of similarity, except in connection with the tests of such screws.

For fluid flows which are appreciably influenced by viscosity yet another condition must be fulfilled to ensure similarity between two motions. Let $\mu$ be the viscosity of the fluid, $\rho$ its density, $V$ the velocity of the body through the fluid, and let $l$ be some length which defines the size of the body—for instance the diameter, if the body be a sphere, or the length, if it be an airship. Then the quantity $\frac{\rho V l}{\mu}$ must have the same value in each of the motions to be compared, otherwise viscosity will play a different part in each motion, and strict similarity will be impossible. This quantity $\frac{\rho V l}{\mu}$ has zero dimensions and is therefore a pure number or ratio, independent of the units in which its separate factors are expressed, provided that those units form a dynamically consistent




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FIG. 1.—THE TURBULENT FLOW OF FLUID PAST A CYLINDER

This illustrates the flow round all bodies which offer a high resistance to rapid motion through fluids. The motion of the fluid, which is from left to right, is characterized by a dead region *a*, followed by a turbulent wake *b*. Such a flow exerts a powerful drag upon the body

system, *i.e.,* a system of units which allows Newton's laws of motion to be expressed in the form:—Force = mass × acceleration, the pound-poundal-foot-second and the gram-dyne-centimetre-second systems being examples. It is universally known as the *Reynolds number,* after the celebrated scientist Osborne Reynolds. When the Reynolds number of a flow is small, viscosity will play a predominating part in the motion, which will be of the kind usually associated with the flow of oils or treacle. When the number is large, the flow will be of the kind usually associated with water, and will approximate to that of an inviscid fluid Thus the same fluid may act in a highly viscous manner when flowing slowly past small objects, and yet behave almost as though inviscid when flowing rapidly past large bodies. The Reynolds numbers which are of interest in aeronautics are of the order of a million; in these circumstances the air behaves almost as though it were inviscid, and the simple laws of comparison between model and full scale, to which reference has been made, can generally be applied without serious error. Certain flows, which are of great

interest in aeronautics (*e g*, the flow about a wing at the stalling angle which is defined later) are, however, highly critical, in the sense that small disturbances may cause an entire change in the type of flow. These critical flows may be sensitive to changes in the Reynolds number, even though the value of the number is very large, and hence the greatest caution must be used in applying the results of small model experiments on these critical phenomena. The highly practical importance of some of these critical flows has led to great efforts being made to devise laboratory experiments in which the Reynolds number will be the same as that of the full scale flow to be represented One way in which this has been successfully accomplished, though at great cost, is to enclose the whole wind tunnel in an air-tight chamber pumped up to a pressure of some 20 atmospheres, this increases $\rho$ some 20 times, which compensates for the reduction in $V$ and $l$ necessary to bring the experiment within the scope of laboratory methods.

## FLUID MOTION

The forms taken by the flow of air past a solid body can in general be classified as belonging to one of two characteristic types. Fig. 1 is typical of the flow around the majority of bodies not specially shaped to move easily through fluids. The motion, which in this figure is from left to right, is characterized by a dead region *a*, of small velocity and low pressure, followed by a turbulent wake *b* Such a flow exerts a powerful drag upon the body, and much energy will be required to force the body rapidly through the fluid. Fig. 2 is typical of the flow around bodies which move easily through fluids, the dead region *a* is absent, whilst the wake has become very small. Flows of this type are generally called *streamline* flows, and bodies which generate them are called streamline bodies. The turbulent flow, as in fig 1, is not yet susceptible to precise mathematical analysis, but streamline flows, as in fig. 2, approximate, when the Reynolds number is large, to the flow of a hypothetical inviscid fluid, the analysis of which has been thoroughly studied.

**Bernoulli's Theorem.**—This famous theorem relates to the steady flow of the hypothetical inviscid fluid, and states that the pressure $p$ and the velocity $v$ at all points on a single streamline are connected by the relation:

$$p+\tfrac{1}{2}\rho v^2=\text{constant.}$$

In most aeronautical problems the air at all points far from the body is assumed to be undisturbed, so that its velocity relative to the body and its pressure are uniform, if these are called $V$ and $P$ respectively, then Bernoulli's equation leads easily to:

$$p-P=\tfrac{1}{2}\rho V^2\left[1-\left(\frac{v}{V}\right)^2\right]$$

from which the pressure at any point can be deduced from the velocity at that point, or vice versa The maximum pressure will thus occur where $v$ is zero, and will have the value of $P+\frac{1}{2}\rho V^2$; this maximum pressure occurs on the surface of the solid body at the point where the streamlines divide. (*See* figs. 1 and 2 ) This fact is used to measure the velocity of air in aeronautical experiments. If a tube, closed at one end and open at the other, is placed with the open end facing the air stream, the pressure within it will have the maximum value $P+\frac{1}{2}\rho V^2$. If the difference between this pressure and the pressure $P$ of the undisturbed stream can be measured and if the density is known, the velocity $V$ can be determined. The undisturbed, or static pressure $P$ can be obtained within a closed tube placed with its axis parallel to the wind and having small holes punctured in its sides at some distance from the closed end. These two tubes are known respectively as the *pitot* and *static pressure* tubes; and together with some form of manometer, for measuring the difference between the pressures within them, they provide the standard speed measuring unit both in the laboratory and on aeroplanes in flight.

**The Flow About a Streamline Body.**—The theoretical study of a hypothetical inviscid fluid leads to the conclusion that when a solid body starts from rest to move through such a fluid, which is otherwise undisturbed, the form of the flow around the body is uniquely determined by its shape and mode of motion. This

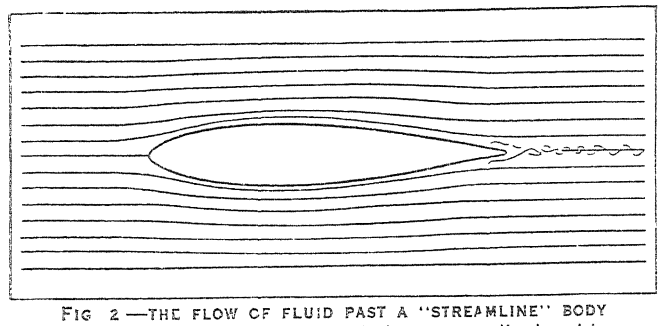


FIG 2.—THE FLOW OF FLUID PAST A "STREAMLINE" BODY
In contrast to the turbulent flow round a body not especially shaped to move easily through fluids as in Fig. 1, this illustrates the flow round a body which offers small resistance to rapid motion through fluids

flow has the remarkable property that, although it may cause variations of pressure which tend to rotate the body, it exerts no resultant force upon the body, no matter what the shape of the body may be. The actual air flow about a streamline body, such as an airship (fig. 2) is a very close approximation to this theoretical flow, and hence the resultant of the pressures upon the surface of the body is almost zero—the small remaining drag, or resistance to motion, being nearly all due to *skin friction*, *i e*, the tangential forces on the surface due to the friction of the air. When the Reynolds number is large, as in aeronautics, the fluid mechanism which exerts these skin friction forces is confined to a very thin sheath, or layer, enveloping the body. This is called the *boundary layer;* the motions within it are very complex and are known to provide the determining factor which decides whether the flow will be streamline or turbulent. Outside this very thin boundary layer the flow, if streamline, behaves very closely as though the fluid were absolutely inviscid.

A wing may be loosely described as a flattened streamline body Its cross section in one plane containing the direction of motion has a typical streamline form, as in fig. 3 (*see* also AEROPLANE) which shows a modern wing section. So long as the incidence, or inclination of this section to the direction of motion is not too great, the flow about the wing will be streamline, the drag will be small and the wing will exert a lift perpendicular to the direction of motion which increases progressively with the incidence. If the incidence becomes too large the flow changes, more or less

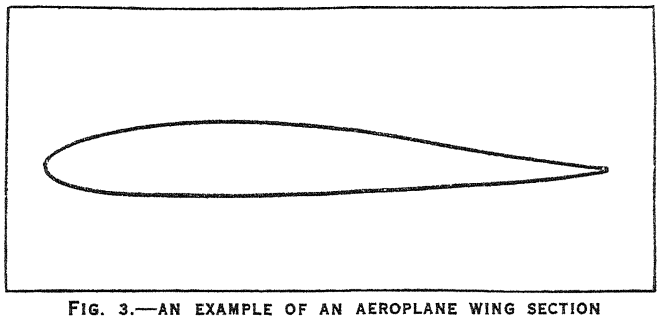


FIG. 3.—AN EXAMPLE OF AN AEROPLANE WING SECTION
The modern type of wing is more or less a flattened streamlined body. The actual air flow about a body of this shape is such a close approximation to the theoretical flow that the pressure upon its surfaces is almost zero

suddenly, to a form similar to that in fig. 1. The wing is then said to *stall* and its resistance to motion is greatly increased, whilst its lift no longer increases with incidence, but may even fall slightly.

Below the *stalling angle* the flow, though streamline, differs from that unique flow which could be generated from rest in an inviscid fluid, and approximates more nearly to one of a series of flows, which are possible to the inviscid fluid, but which could not be generated in it without the action of some additional agency. The way in which these flows are generated is still somewhat obscure, but it is known that their development is made possible by the slight trace of viscosity in the air, which allows eddies to be shed from the trailing edge of the wing, and that as these eddies are shed the flow about the wing changes until the appropriate flow has developed. When these changes have ceased and the flow has become steady the viscosity plays no further appreciable part in the motion, except in the boundary layer. Theoretically

there are, for each wing at each incidence, a series of such flows which could exist steadily in the inviscid fluid but could not be generated in it, and a question arises as to which one of them will occur in any given instance. Unlike the flows which could arise from rest in an inviscid fluid, these flows give theoretically, a lift upon the wing, and if the actual lift of the wing can be measured, the particular flow of this series which is occurring can be identified as that one which theoretically gives the measured lift. It is thus possible, by merely measuring the total lift of a wing, to calculate, with considerable accuracy, the direction and velocity of the flow at all points in its neighbourhood and from Bernoulli's equation the distribution of pressure over its surface. If the lift cannot be measured, the flow can be approximately identified as that one of the series in which the streams flow smoothly off the trailing edge of the wing without sharp changes of direction. This method of identification is not so accurate as the former.

**Induced Drag.**—Calculations such as the foregoing can most conveniently be made in relation to wings of infinite span, or length perpendicular to the direction of motion. For such wings the theoretical drag in the inviscid fluid is zero; the real drag is almost entirely due to skin friction and is so small that it may, in favourable circumstances, be less than one-fiftieth of the lift. When the span of the wing is finite, circulations are set up around the tips, the air flowing round them from the high pressure region beneath to the low pressure region above the wing. Vortices are thus generated, which trail from the wing tips and remain in the air long after the wing has passed. These vortices require power for their generation and consequently the power required per running foot to propel a finite wing, and the drag on the wing, are greater than for a wing of infinite span: for this reason the drag of a wing of practicable shape is seldom less than one-twentieth of the lift. L. Prandtl has developed approximate mathematical methods of calculating this drag, which he calls the *induced* drag. The difference between the actual and the induced drag is called the *profile* drag, because it depends upon the profile, or cross section, of the wing and is not dependent on the span.

For a given wing arrangement, the induced drag is proportional to the ratio, weight supported/span; this ratio is now called the *span loading*. The induced drag varies in *inverse* proportion to the air density and the square of the speed. The profile drag, for a given incidence and profile, depends upon the total wing area and varies in *direct* proportion to the density and the square of the speed. When calculating the drag of an aeroplane wing, it is now normal practice to divide the drag into these two parts and to study them separately. Induced drag can be calculated, not only for single wings, but for multiple wings, as in a biplane, or for wings in the presence of plane boundaries, such as the walls of a wind tunnel or the surface of the earth. Such calculations are used extensively in all modern laboratories and design offices.

## FREE FLIGHT

**Stability.**—An aeroplane which, on being disturbed from a condition of steady flight in equilibrium, ultimately returns to the condition from which it was disturbed, is said to be *stable*. Complete stability in this sense can be achieved by correct proportioning of the parts of the aeroplane, but is by no means necessary for successful flight; for if the pilot has effective control over his aeroplane he can easily check any tendency to depart from equilibrium flight, which may result from a moderate instability. It is, however, important for the designer to know, not only whether his aeroplane will be stable or unstable, but the degree of stability or instability to be expected, for its behaviour in the hands of the pilot will depend upon this factor. The subject has therefore been extensively studied mathematically, but is so complicated that it is impossible here to do more than refer the reader to standard books on the subject.

**Stalling.**—As the speed of an aeroplane falls the lift falls, and sufficient lift to balance the weight can be obtained only by an increase of incidence. But it has been shown in a previous paragraph that when the incidence of a wing passes a certain critical angle the character of the air flow changes, and the lift ceases to increase. There is thus a minimum speed, associated with the above critical angle, at which any aeroplane can fly steadily. This minimum speed of steady flight is called the *stalling speed*, the incidence at which it occurs is called the *stalling incidence*, and an aeroplane flying at an incidence greater than the stalling incidence is said to be flying *stalled*. With this change of flow at the stalling incidence is associated a complete change in the characteristics which determine the stability of aeroplanes and the action of their controls. For the effect of this change upon practical aviation *see* AEROPLANE.

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*See* also:—*Reports and Memoranda of the Aeronautical Research Committee: Reports of the National Advisory Committee for Aeronautics; Technische Berichte der Flugzeugmeisterei.* (B. M. J.)

**AERO ENGINES.** The purpose of the aero engine is to provide propulsive thrust, either by driving a propeller or by high-speed jet reaction. Any suitable power source might be used, but the internal-combustion piston engine and gas turbine predominate because of their low weight and bulk. The gas turbine may be designed to drive a propeller (turboprop) or as a jet propulsion engine (turbojet). Less common internal-combustion types are the ramjet, pulsejet and rocket engines.

## HISTORY

The earliest aero engines were adaptations of existing power units and they achieved some success in powering slow-speed, lighter-than-air craft. In earlier experiments with heavier-than-air craft, the lack of a lightweight engine was a great handicap and no real progress was made until engines were designed specially for aeroplanes.

In 1851 a Frenchman, Henri Giffard, built the first aero engine. It was a steam engine which, with its boiler, weighed 351 lb. and developed only 3 horsepower. Nevertheless, it made possible the first controlled navigation of the air on Sept. 4, 1852, when Giffard piloted his airship from Paris to Trappes. The first internal-combustion engine was flown in 1872 when a German, Paul Haenlein, piloted an airship powered by a four-cylinder piston engine using coal gas fuel. Gasoline fuel was first used in a two-cylinder piston engine used by David Schwarz to propel the first rigid airship in 1897.

**Early Aeroplane Engines.**—The engine used by Orville and Wilbur Wright in the first free flight of an aeroplane on Dec. 17, 1903, was designed and built by them and delivered 12 h.p. for 179 lb. weight. In form it was similar to contemporary automobile piston engines, having four cylinders in-line, with water cooled barrels and air-cooled heads.

In the same year, Charles M. Manly designed and built a noteworthy engine for the ill-fated S. P. Langley "Aerodrome." Manly's engine developed 52 h.p. for 151 lb. weight. Its weight/power ratio of 2.88 lb. per horsepower was remarkably low at that time and compared favourably with the weight/power ratio of similar power engines of much later date. Its five water-cooled cylinders were arranged radially around its crankcase, a form of construction which was maintained throughout the years in the popular air-cooled radial piston engine.

**Engines of World War I.**—During 1914–18 the progress of aero engine development was accelerated considerably by the concentration of effort on the development of the aeroplane as a military weapon. Prominent among early World War I engines were the air-cooled rotary types. These were radial piston engines built in the general form of Manly's engine but radically different in that the cylinders rotated about a fixed crankshaft. Notable examples of the type were the Gnôme, Le Rhône, Clerget and Bentley used by the Allies and the Oberursel-Gnôme and Goebel of the Central Powers. These engines developed 80 h.p. to 230 h.p. and weighed 1.9 lb. to 3 lb. per horsepower. The rotary engine suffered from many inherent disadvantages but, in comparison with the more conventional engines currently available, it had the important advantages of lower weight and smoother running.

Design refinement of the in-line water-cooled engine reduced its

weight and introduced a new generation of Allied engines with 8 or 12 cylinders arranged in two banks in V form. Noteworthy among these were the 300-h.p. Hispano-Suiza (France), the 350-h p. Rolls-Royce Eagle (Great Britain) and the 420-h.p. Liberty (U.S.); the European engines had weight/power ratios around 2 3 lb. per horsepower compared with 2.11 lb. per horsepower for the Liberty. Contemporary with the Allied Powers' V types were the six-cylinder in-line Mercedes, Benz and Maybach engines of the Central Powers, ranging from 100 h p. to 260 h.p. and weighing more than 3.5 lb. per horsepower.

Notable engines under development in Britain when World War I ended were the 380 h p. Cosmos Jupiter (later taken over by the Bristol company), a nine-cylinder air-cooled radial weighing about 1 7 lb. per horsepower; the 450-h p Napier Lion, a 12-cylinder, three-row, in-line water-cooled engine weighing 1.86 lb. per horsepower; and the 300-h.p. air-cooled Armstrong-Siddeley Jaguar. The Jaguar was the first aero engine to be designed with a mechanically driven supercharger.

**Between Wars, 1918–39.**—In this period a remarkable advance in aero engine efficiency was achieved and many long-distance flights demonstrating improved reliability were accomplished. Noteworthy among these was the first nonstop Atlantic crossing on June 14–15, 1919, by John Alcock and Arthur Brown in a Vickers' Vimy bomber powered by two 350-h p. Eagle engines. Improved fuels and supercharging played a large part in increasing output from about 500 h p. to 1,000 h.p and reducing the weight/power ratio from about 1.5 to nearly unity.

Development was intensified in the 1930s, particularly in Europe. In 1932 the Bristol Aeroplane Company, Ltd , produced the first aero sleeve-valve engine, the nine-cylinder air-cooled radial Perseus of 560 h.p., and in 1934 the Rolls-Royce Merlin started its long and illustrious career at about 900 h.p. A noteworthy engine of this era was the 600-h p. Junkers Jumo 205C two-stroke diesel. In the United States, the General Electric company brought to fruition the exhaust turbosupercharger, an idea which dated back to World War I and which had been the subject of experiment in many countries at various times.

**Engines of World War II.**—Again the influence of war resulted in an accelerated rate of engine development, best illustrated perhaps by the Merlin, which earned fame by powering Hurricane and Spitfire fighters in the battle of Britain. The military rating of the Merlin rose from 1,030 h.p. in 1939 to 1,830 h.p. in 1945. Its weight/power ratio based on these figures fell from 1.33 lb. per horsepower to 0.94 lb. per horsepower.

Apart from the development of particular engines to higher power by supercharging, etc., as in the case of the Merlin, larger engines were introduced into service as the war progressed and, by 1945, engines of 2,500 h.p. were in use. These larger engines succeeded in pegging weight/power ratio near unity in spite of the unfavourable influence of scale effect.

The liquid-cooled V and air-cooled radial types predominated in combat aircraft used by the Allies and axis powers. A significant difference in German engines was the use of direct fuel injection into the engine cylinders in place of the carburettor or bulk injectors used on Allied engines.

New basic engine types were introduced by both sides during the last year of the war. Of particular interest was the German use of a rocket engine in interceptor fighters, and a pulsejet engine in the V-1 missile. The V-1 brought the British Meteor fighter, powered by two Rolls-Royce Welland turbojets of 1,600 lb. static thrust, into service in Great Britain in 1944 as a defense measure.

British and German turbojet fighters appeared on the western front in 1945. By this time, the Meteor had two Rolls-Royce Derwent Mark 1 engines of 2,000 lb. thrust, weighing 0.48 lb. per pound thrust. German turbojets were heavy and uneconomical in comparison; *e.g.*, the widely used Jumo 004B gave 1,980 lb. thrust and weighed 0.82 lb. per pound thrust.

**Advent of the Gas Turbine.**—The first gas turbine to fly powered a Heinkel jet aircraft flown in Germany in Aug. 1939. Development of the Heinkel turbojet was abandoned, however, and the axial type subsequently developed in Germany had not flown when Frank (later Sir Frank) Whittle's W.1 turbojet powered the Gloster E 28/39 aeroplane on its maiden flight in Britain on May 14, 1941. Whittle's W 1 engine, which gave 855 lb thrust and weighed 620 lb., was the direct ancestor of a line of centrifugal turbojets designed by Rolls-Royce in Britain and the General Electric company in the United States.

Conversion of the Rolls-Royce Derwent turbojet by fitting a propeller and reduction gear produced the Trent experimental turboprop which powered a Gloster Meteor aircraft and thus became the first turboprop to fly (Sept. 20, 1945). The Trent gave 790 h p. and 1,220 lb. jet thrust.

By mid-century the turbojet had replaced the piston engine in most fighter aircraft and in some bombers. The appearance of the first turboprop air liner prototype, the Vickers Viscount, in Britain in 1948, and the first turbojet air liner prototypes in Canada (A V Roe C 102) and Britain (Comet) in 1949, indicated the strength of the challenge of the gas turbine in the transport field.

## GENERAL REQUIREMENTS

The design of an aero engine is governed by four major considerations It must be reliable and give a period of useful operation between overhaulings sufficiently long to make it an economic proposition Its weight and fuel consumption must be as low as possible and its frontal area must be as small as possible Reliability and long life must always be the primary considerations, although they may have to be sacrificed temporarily in cases of extreme military emergency. The order of importance of the remaining criteria is determined by the speed, operating height and range of the aircraft for which the engine is intended. The aero engine design problem involves an attempt to satisfy simultaneously these interrelated and sometimes conflicting requirements.

**Reliability.**—The failure of an aircraft engine is a serious matter if, as a result, the pilot has inadequate power to manoeuvre his aircraft as he desires. Although modern civil aircraft are designed, in accordance with an international agreement, to have adequate reserves of power to meet all reasonable cases of engine failure, reliability remains as the first criterion of aero engine design and each individual engine type is subjected to exhaustive tests totalling thousands of hours, both on the ground and in flight, before being certified as an airworthy type for installation in production aircraft. A similar high design standard is set for all accessories and systems on which the engine depends, such as propellers, fuel and oil systems, etc.

Reliability in an efficient aero engine is not easily obtainable because of the importance of the simultaneous achievement of low weight, which entails minimum scantlings stressed to the economic optimum and a never-ending search for improved materials to carry high stress at elevated temperatures.

**Low Weight.**—The maximum weight of an aeroplane at take-off is limited by its take-off performance or by the strength of its structure. The importance of lightweight design of every component, including the power plant, is best illustrated by a simplified example relating to a typical piston-engined air liner with a maximum take-off weight of 100,000 lb. In round figures, the aircraft structure weighs 30,000 lb., the power plant 20,000 lb. and crew and equipment 10,000 lb., giving a total equipped weight of 60,000 lb. The remaining 40,000 lb. is disposable load, to be allocated between fuel and pay load (passengers and cargo) according to the distance to be flown.

When flying the maximum distance, with tanks filled to capacity, the maximum fuel weight is 35,000 lb., leaving 5,000 lb. for pay load. In this case, the pay load, which determines the revenue and profit of the operator, is only 5% of the take-off weight and it is easily verified that a small percentage decrease of the equipped weight produces a large percentage increase of the revenue-producing pay load. For example, 10% reduction of power plant weight, 2,000 lb., would give a 40% increase of pay load.

The foregoing applies to an existing aircraft with a fixed structure weight. Considering a new design, a reduction of equipment weight permits reduction of wing area and structure weight, and a lighter and smaller aeroplane requiring less power and fuel can be designed for given range and pay load. Reduced first costs (proportional to weight) and lower operating costs result.

**Low Fuel Consumption.**—It is clear from the foregoing that similar benefits derive if the fuel load is reduced by lowering the specific fuel consumption of the engine; that is, fuel consumption rate per horsepower developed, or pounds per horsepower per hour. The benefits resulting from reduction of fuel load may be slightly smaller than those obtained from an equal reduction of equipment weight for two reasons: first, because the mean aircraft weight is higher, and slightly higher power (and fuel consumption) is required during the flight; second, because it is possible to arrange the fuel tankage in a new aircraft design in such a manner that alteration of the fuel load has little effect on structure weight Nevertheless, achievement of minimum fuel consumption is an important objective, particularly when considering aircraft designed to fly great distances.

**Interrelation of Weight and Fuel Consumption.**—Power plant weight and fuel consumption must be considered simultaneously in order to determine the most suitable type of power plant for a particular aircraft role. The obvious criterion is the sum of the power plant weight and the weight of fuel consumed by the engine during a specified time at a specified height, power and air speed Different types of power plant may be compared in this manner but it should be noted that the method does not include the effects of the different engine types on the aircraft configuration and performance, and the answer obtained must be regarded as a first approximation. Borderline cases must be the subject of detailed aircraft design studies, to make certain of choosing the most suitable engine type.

Comparison of the turbojet with the piston engine and propeller combination provides an interesting example of the interrelation of weight and fuel consumption. At a moderate air speed, say 400 m.p.h., the turbojet consumes fuel at approximately twice the rate of the piston/propeller for the same thrust-horsepower but its power plant weight is only about one-third that of the piston/propeller. The difference of power plant weight in favour of the turbojet is exploited by carrying additional fuel in the jet aircraft, thus enabling it to compete with the piston-engined aircraft up to at least 1,000-mi. range at 400 m.p.h.

**Small Size.**—"Parasitic drag," which represents a considerable proportion of the total drag of an aeroplane, is dependent on the frontal area of the aircraft. It increases as the square of the air speed up to speeds in the region of acoustic velocity where it begins to increase even more rapidly. In addition, changes of frontal cross section (*e.g.*, large engine nacelles on thin wings) are a source of unwanted drag at high air speeds.

The engine which can be installed entirely within the aircraft contours necessary to house the specified load makes an invaluable contribution to the important objective of minimum aircraft frontal area. The engine which adds to the frontal area must be debited with the concomitant drag increase.

**Altitude Power.**—Atmospheric density falls rapidly as altitude increases, reaching 20% of its sea level value at 44,000 ft. As the internal-combustion engine burns an approximately constant volume of air-fuel mixture in unit time, it follows that the weight of air-fuel mixture per unit time and the power extracted therefrom vary almost directly with atmospheric density, unless steps are taken to restore sea level conditions at the engine induction manifold by precompression in a supercharger.

In the piston engine, the power absorbed in overcoming internal friction is appreciable, and is independent of atmospheric density. In an unsupercharged engine, therefore, the power available to drive the propeller falls more rapidly than the atmospheric density, reaching about 9% of sea level power at 44,000 ft. An unsupercharged engine developing 1,000 h.p. at 44,000 ft. would be about 11 times the size and weight of an engine developing 1,000 h.p. at sea level, but if supercharged to 44,000 ft. it would be of reasonable size and weight.

In comparison with the piston engine, the gas turbine mass air flow falls less rapidly with increase of altitude and its internal friction losses are negligible. Furthermore, its mass air flow increases appreciably with increase of air speed. Thus, the turboprop is able to maintain its sea level power (static) up to 20,000 ft. at 400 m.p.h.

## DESIGN PROBLEMS: GASOLINE PISTON ENGINES

**Detonation.**—The dominating factor in gasoline engine design is a combustion phenomenon termed "detonation." When detonation occurs the flame spreads throughout the charge in the cylinder at greatly accelerated speed, creating a high-pressure gas wave which produces an audible knock, akin to the noise of a hammer blow on metal, when it reaches the cylinder wall. Mild intermittent detonation is not serious. Prolonged violent detonation frequently results in piston failure In a given engine, the tendency to detonate varies with the type of fuel used, and detonation may be suppressed by injecting water, alcohol or water-alcohol mixtures into the induction system.

With a given fuel, the major factors affecting detonation are the air/fuel ratio and the pressure and temperature of the compressed mixture in the combustion chamber. A mixture rich in fuel defers the onset of detonation High pressure and temperature have the opposite effect In different engines using the same fuel, design details, such as the shape of the combustion chamber and the relative positions of spark plugs and valves, exert considerable influence on detonating tendencies.

**Compression Ratio.**—Power output and specific fuel consumption are governed by the engine compression ratio· that is, the ratio of the maximum cylinder volume (piston at bottom) to the combustion chamber volume (piston at top). High compression ratio yields high power and low specific consumption, but it entails high pressure and temperature of the air-fuel mixture after compression and, therefore, increased tendency to detonate The type of fuel available thus limits the maximum compression ratio and consequently limits maximum power output and minimum specific consumption.

**Supercharging.**—Supercharging involves the provision of a compressor which delivers air or air-fuel mixture at a pressure and temperature above those of the atmosphere. Although introduced originally for the purpose of maintaining sea level pressure in the induction manifold at altitude, the principle was extended to provide higher manifold pressures in order to increase power output and reduce weight/power ratio.

Increase of manifold pressure and temperature results in higher pressure and temperature of the air-fuel mixture in the cylinder after compression and increased tendency to detonate. With a given fuel, a choice must be made between a high degree of supercharge coupled with low compression ratio, and low supercharge with high compression ratio. The former yields an engine of small bulk with low weight/power ratio and high specific fuel consumption; the latter choice, a larger and heavier engine with lower specific consumption.

The centrifugal compressor established its supremacy at an early stage in supercharging experiments and maintained it thereafter. It accelerates the air to high velocity in a radial-vaned impeller and converts the kinetic energy into static pressure in a diffuser.

In many applications the supercharger is mechanically driven from the engine crankshaft through a speed-increasing gear. Ideally, the drive should provide variable speed in order to avoid unnecessary power loss at low altitude, but the added complication of a variable-speed drive is not warranted in many cases. A concession is often made by providing a two-speed drive.

The exhaust turbosupercharger is driven by a turbine deriving its power from the engine exhaust. In addition to using energy which might otherwise be wasted, this method of supercharging provides variable-speed drive without mechanical complication.

**Air/Fuel Ratio (Mixture Strength).**—The range of ignitable air-gasoline mixtures is reasonably wide. For each engine throttle setting there is an air/fuel ratio yielding maximum power, and a higher ratio (weak mixture) giving minimum specific consumption at lower power. Air/fuel ratios below the optimum for power (rich mixture) reduce power and increase specific consumption.

The antidetonating effect of rich mixture is exploited by using high manifold pressure to give high power for short period operation; *e.g.*, at take-off, when consumption is unimportant. Detonation limits the use of weak mixture to cruising power, where minimum consumption is essential. Fortunately, the magnitude of the effect of air-fuel ratio on detonation is such that an acceptable

cruising-take-off power ratio is obtained.

Equal distribution of both fuel and air to all cylinders is important since the air-fuel ratio in the worst cylinder limits the performance of the whole engine.

**Cooling System.**—If the engine cylinders, and particularly the cylinder heads, are not adequately cooled the performance deteriorates and engine failure may result. On the other hand, overcooling must be avoided. It is not necessarily beneficial to the engine and it entails unnecessarily high cooling system drag. Equal cooling of all cylinders must be achieved if one cylinder is not to limit performance unduly.

The relative merits of air cooling and liquid cooling have been debated frequently. The fact that both survived in competition presents adequate proof that there are advantages peculiar to each system.

The oil used to lubricate bearings, gears, etc., absorbs heat in its passage through the engine and must be kept below a maximum temperature limit if its lubricating qualities are to be maintained. Again, overcooling is undesirable since, in addition to unnecessary drag, a film of oil may congeal on the metal surfaces of the cooler and eventually render it ineffective.

## PISTON ENGINE TYPES

Aero piston engines are classified according to cooling system, arrangement of cylinders, heat cycle, etc The four-stroke, spark ignition, gasoline cycle predominates to such an extent that its use may be assumed unless specifically stated otherwise. Conventional poppet valves in the cylinder head may be assumed also in the absence of a contrary statement. The most popular types in the larger engine sizes are the air-cooled radial and the liquid-cooled **V**.

**Air-Cooled Radial.**—A notable engine of this type was the 18-cylinder, two-row, sleeve-valve Bristol Centaurus, descendant of the first sleeve-valve engine (Perseus) of 1932. The Mark 662 operating on 115/145 grade fuel develops 2,810 h.p. at 2,900 r.p.m. for take-off; 2,405 h.p. at 7,750 ft. and 2,280 h.p. at 16,000 ft., in low- and high-speed supercharger drive, respectively, when cruising at 2,400 r.p.m. It weighed 3,270 lb., giving a weight/power ratio of 1.16 lb. per horsepower; its diameter was 56.6 in.

The largest radial engine at mid-century was the four-row, 28-cylinder Pratt and Whitney Wasp-Major. Model B.13 operating on 115/145 grade fuel developed 3,250 h.p. at 2,700 r.p.m. for take-off; 2,650 h.p. at 6,000 ft.; and 2,300 h.p. at 16,300 ft., when cruising at 2,550 r.p.m. It weighed 1.08 lb. per take-off horsepower and its diameter was 54 in.

**Liquid-Cooled V.**—Developed from the World War II Merlin, the Mark 620 was an excellent example of the type. It employed a very high degree of supercharge necessitating a two-stage, two-speed supercharger to obtain the required pressure ratio and a charge cooler to reduce the induction temperature. The coolant used in both radiator and charge cooler was a mixture of water and ethylene-glycol.

The Mark 620 gave 1,725 h.p. for take-off at 3,000 r.p.m. on 100/130 fuel. For cruising, 1,180 h.p. was obtained at 2,650 r.p.m. at 10,500 ft.; and 1,165 h.p. at 2,850 r.p.m. at 23,750 ft., in low and high supercharger gears, respectively. It weighed 1.01 lb. per take-off horsepower and its maximum height and width were 43.2 in. and 31.3 in., respectively

**Air-Cooled V.**—Eight- and twelve-cylinder engines of this type at mid-century ranged in power from 150 h.p. to 600 h.p. and in weight/power ratio from 2.4 lb. to 1.4 lb. per horsepower.

**H or ⌅ Engines.**—This cylinder arrangement was developed in both air-cooled and liquid-cooled forms, the largest engine of the type being the 24-cylinder, sleeve-valve, liquid-cooled Napier Sabre. The Mark 5 Sabre gave 2,565 h.p. at 3,850 r.p.m. for take-off on 100/130 fuel, for a weight of 0.95 lb. per horsepower.

**In-Line Engine.**—This type survived mainly in small four- or six-cylinder engines suitable for light aircraft operating on lower-grade fuel. At mid-century these ranged in power from 90 h.p. to 380 h.p. and in weight/power ratio from 3.0 lb. to 1.65 lb. per horsepower.

**Flat Engine.**—Designed for mounting within the contours of the aeroplane wing, the flat engine virtually consists of two horizontal in-line engines operating on a common crankshaft. Engines of the type have two, four, six or eight cylinders, are mainly air-cooled and use lower-grade fuel. They ranged from 20 h.p. to 320 h.p. at mid-century and from 3.0 lb. to 1.8 lb. per horsepower.

**Two-Stroke Gasoline.**—The two-stroke cycle attracted much attention throughout the history of aero engines, because of potentially greater power for a given engine size and correspondingly low weight/power ratio. The type was not brought to fruition in a large gasoline engine although small unsupercharged aero engines of 20 h.p. to 60 h.p. continued to be marketed. These had a good weight/power ratio for their size, offset by high fuel consumption.

**Diesel Engine.**—The low specific consumption achieved by diesels in other forms of transport naturally attracted much attention and aero diesels were developed in several countries at various times The most successful, in that it was used in commercial and military aircraft, was the six-cylinder opposed-piston, two-stroke Junkers Jumo 205C, which developed 600 h.p. and had a specific consumption of 0.38 lb per horsepower per hour. Its weight/power ratio of 1.85 lb. per horsepower, though low for a diesel, was sufficiently high to limit its use to relatively long-range aircraft.

**Composite Engine.**—The composite engine is a combination of two engines of basically different design; *e.g.*, a piston-turbine combination. Such designs usually aim at higher power and lower specific consumption by utilization of the waste heat in the piston engine exhaust. An excellent example of a simple form of composite engine was the Wright Turbo-Cyclone 18, which combined the 2,700 h.p. R.-3,350 with three impulse exhaust turbines delivering power to the engine crankshaft through reduction gearing. A 20% increase of power and an equivalent reduction of specific consumption was claimed for this arrangement.

## DESIGN PROBLEMS: TURBINE ENGINES

The essential components of the aero gas turbine are its compressor, combustion chamber (or chambers) and turbine. In the turbojet, the power developed by the turbine just balances the power required to drive the compressor, and the engine output is measured in terms of a thrust force (pounds weight). In the turboprop, additional power is developed by the turbine to drive the propeller, and the output is measured in terms of horsepower plus a small residual thrust component. High power (thrust) output and good economy demand high compressor and turbine efficiencies and high combustion efficiency coupled with minimum pressure loss in the combustion system.

In contradistinction to the intermittent combustion of fuel at approximately constant volume in the piston engine, combustion in the aero gas turbine occurs continuously at nearly constant pressure. The design variables affecting the power output and fuel economy of the constant pressure heat cycle, namely the compressor pressure ratio, the maximum cycle temperature (or turbine inlet temperature) and the propulsive efficiency of the power plant at the appropriate aircraft speed and altitude, are closely interrelated.

**Propulsive Efficiency.**—Propulsive efficiency is the ratio of the power usefully employed in propelling the aircraft to the power available in the engine. It is a maximum when the difference between aircraft speed and jet velocity is small. In this respect, there is no fundamental difference between the engine-driven propeller and jet propulsion.

The propeller employs low jet velocity in relation to aircraft speed and therefore attains high efficiency; *e.g.*, 85% up to about 450 m.p.h. air speed. Above this air speed the efficiency of the conventional propeller drops rapidly because of the inefficiency of its blades as airfoils at speeds (including rotational component) approaching acoustic velocity. At 700 m.p.h. its efficiency may be 50% or less.

The turbojet employs high jet velocity (1,000 m.p.h. to 1,500 m.p.h.), and at 300 m.p.h. air speed its propulsive efficiency is about one-half that of the propeller.

As aircraft speed is increased, the diminishing difference between jet velocity and aircraft speed rapidly improves jet efficiency, which reaches parity with propeller efficiency at about 550 m.p.h. (55%–70%). At 700 m.p.h., jet efficiency is 65%–80% compared with 50% or less for the conventional propeller. These propulsive efficiency values largely explain the high fuel consumption of the turbojet at low air speed and its superiority at high air speed.

**Turbine Inlet Temperature.**—High turbine inlet temperature in the aero gas turbine yields maximum power, minimum weight and minimum frontal area, and, in the turboprop, minimum specific fuel consumption. In the turbojet, however, specific consumption increases with the increase of turbine inlet temperature unless the compressor pressure ratio is raised simultaneously. Since material strength properties are seriously reduced at high temperature, an increase of turbine inlet temperature demands improved materials for the combustion chamber, turbine, etc., or direct cooling of these items, unless engine reliability is to suffer. With materials available at mid-century, turbine inlet temperatures of 800°–850° C. (1,470°–1,560° F.) were in common use.

**Pressure Ratio.**—For a given value of turbine inlet temperature, there is an optimum value of compressor pressure ratio yielding maximum power and minimum weight-power ratio. Increase of pressure ratio above this optimum value reduces power but may improve specific fuel consumption if compressor efficiency can be maintained at a high level as the pressure ratio is increased.

The operating height and speed of the aircraft also affect the optimum pressure ratio, and the selection of a pressure ratio and turbine inlet temperature in a new engine design normally entails a compromise based on the relative importance of engine weight, frontal area and

specific fuel consumption in the type of aircraft for which the engine is intended.

## TURBINE ENGINE TYPES

Gas turbine engines are classified according to the type of compressor used, centrifugal or axial, the centrifugal type being similar in principle to the piston engine supercharger. In the axial compressor air is constrained to move along a contracting annulus between a stationary casing and a moving rotor, by the action of alternate rows of fixed and moving airfoil blades which are mounted radially in the casing and rotor respectively. In comparison with the centrifugal compressor, the axial has lower frontal area for the same mass air flow (and power) and higher compression efficiency at the higher pressure ratios necessary for improved fuel economy.

**Centrifugal Turboprop.**—An example of the type was provided by the Armstrong Dart, with a two-stage, single-sided compressor driven by a two-stage turbine, which also drove the propeller through reduction gearing. The Dart had seven combustion chambers and developed 1,400 s.h.p. (shaft horsepower) and 365 lb. jet thrust, or 1,540 e.h.p. (equivalent horsepower = shaft horsepower plus jet thrust divided by 2.6), for take-off at 14,500 r.p.m. The Dart weighed 930 lb., giving it a weight/power ratio of 0.6 lb. per equivalent horsepower; its diameter was 38.5 in.

**Axial Turboprop.**—In the smaller sizes, the low frontal area of the axial is offset to some extent by the grouping of engine auxiliaries around it. Nevertheless, the Armstrong Siddeley Mamba, giving 1,420 e.h.p. for take-off at 15,000 r.p.m. inside 31 in. diameter, provided a good illustration of low frontal area. The Mamba was similar to the Dart in mechanical arrangement, having a two-stage turbine and six combustion chambers. Its weight/power ratio was 0.54 lb. per equivalent horsepower.

In the 3,500-e.h.p. Bristol Proteus design length was saved at the expense of diameter by grouping the combustion chambers around the axial compressor. Even so, its diameter was the same as that of the Dart (38.5 in.) and about 70% of that of an air-cooled radial piston engine of equivalent power. The Proteus was noteworthy for its "free turbine" arrangement—the first two stages drove the compressor; the final (third) stage was on a separate shaft and drove the propeller through reduction gearing.

The Mamba and Proteus were also produced in coupled form; that is, two engines driving a contrarotating propeller through a common reduction gearbox. Coupling is a convenient way of doubling power plant output and has the potential advantage of better fuel economy at low or medium altitude where part-load specific consumption may be improved by stopping one engine of the pair.

An interesting example of a coupled turboprop was the Allison Model 500, which developed about 5,500 e.h.p. and weighed only 0.48 lb. per equivalent horsepower.

**Centrifugal Turbojet.**—The influence of the Whittle W.1 design can be traced in the Rolls-Royce Nene of 49.5 in. diameter, with a double-sided impeller driven by a single-stage turbine and combustion chambers. It gave 5,000 lb. thrust for take-off at 12,500 r.p.m. and weighed 0.35 lb. per pound thrust. This engine was built under licence by Pratt and Whitney (Turbo-Wasp).

Comparable to the Nene but featuring the single-sided impeller of the piston engine supercharger was the Goblin by de Havilland Ghost, power plant of the prototype Comet. It weighed 0.44 lb. per pound thrust and had a diameter of 53 in.

**Axial Turbojet.**—The General Electric J.47, giving 5,000 lb. thrust for take-off at 7,950 r.p.m. within 37 in. diameter and weighing 0.51 lb. per pound thrust, provided an interesting comparison with similar thrust centrifugal turbojets.

The use of a single annular combustion chamber, pioneered by Metropolitan-Vickers in Great Britain, is desirable if full advantage is to be gained from the low frontal area of the axial compressor. This is illustrated in the Westinghouse J.34, which gave 3,500 lb. thrust for take-off at 12,500 r.p.m. within 28 in. diameter and weighed 0.39 lb. per pound thrust.

**Turbojet with Reheat.**—The turbojet exhaust is sufficiently rich in oxygen due to high air-fuel ratios used, to support combustion of additional fuel downstream of the turbine, a process termed "reheat" or "afterburning." The absence of moving parts downstream of the combustion zone permits the use of high reheat temperatures, and static thrust increases of the order of 50% are theoretically possible. In flight the percentage increase of net thrust is doubled at high air speeds. Reheat is similar in principle to the ramjet and involves over-all flight specific consumptions two or three times those of the basic turbojet. Because of its high fuel consumption reheat is suitable for short period operation only.

## OTHER JET TYPES

**Ramjet.**—Essentially the ramjet consists of an intake designed to convert the kinetic energy of the air to static pressure, a combustion chamber and final expansion nozzle. In principle it is similar to the turbojet, but the absence of moving parts permits operation at much higher temperatures. Because it depends on air speed to obtain the necessary pressure ratio, it needs external assistance to reach the designed operating speed and become self-sustaining.

There was little factual data available on ramjet performance at mid-century. Its major advantage is extremely low weight, but it requires speeds of the order of 1,500 m.p.h. before its specific fuel consumption becomes competitive with that of the turbojet with reheat.

**Pulsejet.**—The pulsejet engine, as developed in Germany, has no moving parts except for numerous flexible reed valves completely covering the intake and controlled by pressure fluctuations produced by intermittent explosions in the combustion chamber behind them. The engine is self-starting and, unlike the ramjet, develops static thrust. Its advantages are low weight and cost, but its specific consumption is high (three to four times that of turbojet). As used in the V-1 missile its useful life was limited by inlet valve failure to less than two hours.

**Rockets.**—The fact that its propellents contain both fuel and oxidizer simultaneously confers upon the rocket motor the unique advantage of independence of atmospheric conditions and the disadvantage of extremely high propellent consumption rate, offset to a small extent by low engine weight. High jet velocities (3,500 m.p.h.–5,000 m.p.h.) are generated, resulting in low propulsive efficiency at low air speeds. Clearly, the most efficient use of the rocket motor involves extremely high operating heights and air speeds.

Solid propellent rockets were used extensively in World War II, to assist the take-off of highly loaded aircraft. This is a special case in which the propellent weight is consumed before the take-off is completed and the dead weight of fixtures may be jettisoned. Rather similar considerations apply to the suggested use of rockets for climb boost on turbojet-engined aircraft.

Liquid propellent rockets were used as the sole propulsive unit in several aircraft, notably German interceptor-fighters and the experimental U.S. Bell X.1, which was reported in 1949 to have exceeded acoustic velocity. The Walter 109-509-A.1 motor of the ME 163 weighed 370 lb. and gave 3,740 lb. thrust for a specific propellent consumption of 20.6 lb. per hour per pound thrust. The propellents were 80% hydrogen peroxide (oxidizer), and a fuel mixture of 57 parts methyl alcohol, 13 parts water and 30 parts hydrazine hydrate—the latter to produce spontaneous ignition in the combustion chamber. The Reaction Motors 6,000-C4 motor of the X.1, weighed 380 lb. and gave 6,000 lb. thrust for 17.2 lb. per pound thrust per hour specific consumption. The propellents were liquid oxygen and 75% ethyl alcohol.

Many possible combinations of chemical substances were suggested for rocket motors to reduce propellent consumption and provide greater safety. The monopropellents, containing both fuel and oxidizer in a single substance (*e.g.*, hydrogen peroxide and nitromethane), are of interest as a move in the direction of greater simplicity.

## FUELS AND LUBRICANTS

The most significant of many requirements common to all aero engine fuels are high calorific value, low freezing point and low volatility. They must also be relatively free from harmful impurities.

Calorific value is a measure of the heat energy released by combustion, and high calorific value yields low specific consumption. Hence the extensive use of hydrocarbon fuels derived from petroleum.

The freezing point, defined in terms of wax deposition, which may clog filters, etc., in the fuel system, is usually specified as not higher than —60° C. (—76° F.).

Low volatility reduces the likelihood of fire if fuel is accidentally spilled over hot surfaces; *e.g.*, during a crash landing.

**Gasoline.**—The two most important characteristics of gasoline fuels are volatility and detonation resistance. Volatility affects the combustion process, particularly when operating at low air temperatures. High volatility aids starting while low volatility may initiate rough running and adversely affect piston engine specific consumption. On the other hand, highly volatile fuel may "boil" in the aircraft tanks at altitude with consequent loss of fuel vapour through the tank vents and interruption of the fuel flow to the engine resulting from vapour locking in the fuel system.

The antidetonating qualities of gasoline fuels are determined by comparative testing against reference fuels of known detonations resistance in a standard test engine. The test procedure covers air/fuel ratio effects, and fuels are graded by awarding performance numbers; *e.g.*, 115/145 grade, indicating relative detonation resistance weak/rich. Single grading numbers of 100 or lower (*e.g.*, 87 octane) derive from an earlier test procedure which compared a given fuel, at one mixture strength only, with blends of iso-octane (high detonation resistance) and heptane (low detonation resistance), octane number being simply the percentage of iso-octane in the iso-octane-heptane blend of equivalent detonation resistance. The limit of the octane scale is 100 corresponding to 100 performance number.

Tetraethyl lead (T.E.L.) is extremely effective in raising the detonation limit of most hydrocarbon fuels. Its use introduces extra design problems in high-duty engines, but the results achieved fully justify the additional design effort.

**Turbine Fuels.**—With minor mechanical modifications the aero gas turbine can be adapted to burn a variety of hydrocarbon fuels ranging from diesel oil to low specific gravity gasoline. The optimum fuel is that giving the highest specific gravity (and calorific value) consistent with a freezing point of —60° C. or thereabouts and low volatility. In the absence of a detonation problem on the gas turbine, these requirements are not incompatible and are met by a fuel similar to the vapourizing oil used in farm tractors, etc.

**Lubricants.**—The aero piston engine demands a high-viscosity oil because of the high loadings of its bearings and propeller reduction gear teeth, both reduced to minimum proportions to achieve low weight The change of oil viscosity with temperature should be small to avoid engine starting troubles at low temperatures.

Turbojet engines normally use ball and roller bearings and operate on thinner oil, with consequent alleviation of the low-temperature starting problem.

The turboprop demands a compromise between the requirements of its ball and roller main bearings and its reduction gearbox

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(R. H. W )

**AEROLOGY, AEROLOGIST.** In general, words denoting respectively the study of the atmosphere and one who is an expert in that study, hence synonymous with meteorology (*q v.*) and meteorologist. Frequently, however, and particularly among professional meteorologists, these terms are used with exclusive reference to the upper air But this use gradually declined in the United States because after 1917 in the U S. navy aerology has been the official term for the science and practice of meteorology, including weather forecasting. Navy weather officers are aerologists.

(R. G. SE )

**AERONAUTICAL ARTICLES.** The subject of aeronautics is treated in several series of articles Under FLIGHT (NATURAL), will be found a study of birds' flight. From this readers can pass to a general survey of artificial flying under AERONAUTICS and AVIATION, CIVIL. Famous flights are discussed under TRANS-OCEANIC AND TRANS-CONTINENTAL FLIGHTS.

The navigation and development of the balloon, and its transformation into an airship, can be studied in the articles BALLOON; AIRSHIP; and AIRSHIP SHEDS. Heavier-than-air flying machines are treated in the articles AEROPLANE; BIPLANE; MONOPLANE; HELICOPTER; ORNITHOPTER; GYROPLANE; and AILERON.

Flying machines capable of alighting upon water are dealt with in the article SEAPLANE; in this connection the article AIRCRAFT CARRIERS studies an important factor in the application of flying machines to naval warfare The question of aircraft terminals and accommodation is treated in the articles AERODROME and AIRSHIP SHEDS. For engine details *see* the articles AERO ENGINES; INTERNAL COMBUSTION ENGINES; and AIRSCREW. The practical navigation of aircraft and their employment for various purposes can be studied in the articles entitled AERIAL NAVIGATION, and AVIATION, CIVIL. There are special articles on the PARACHUTE; AERODYNAMICS; and AERIAL LAW.

**AERONAUTICS.** The record of man's attempts to fly goes back into the remote past. The story of Icarus is a myth founded perhaps on some early failure to imitate the birds. Leonardo da Vinci thought and wrote about it, and there are some references to the subject in the works of Francis Bacon. In 1617 Fleyder of Tübingen lectured on flying; while in Italy, again, in his book *De motu animalium* (1680), G. A. Borelli discussed the question in connection with the strength of man's muscles and came to the conclusion that such flight was impossible.

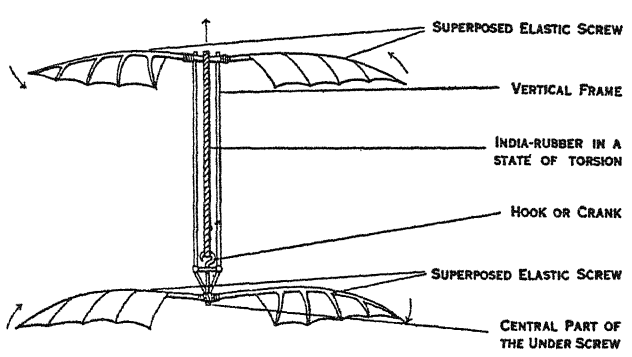



FIG. 1.—PENAUD'S HELICOPTER OR SCREW MODEL BUILT IN 1872 MOST OF THE PIONEERS IN AERONAUTICS DIRECTED THEIR ATTENTION TO THE CONSTRUCTION OF MODELS CAPABLE OF VERTICAL FLIGHT

**Early History of Artificial Flight.**—We are here concerned mainly with the flight of bodies heavier than air; for the early history of airships *see* BALLOON and AIRSHIP The first attempts, limited in all cases to the flight of models, were generally based on the endeavour to imitate the action of a bird's wings Sir George Cayley, however, in 1796, constructed a tiny helicopter in which two windmills made of gull feathers were caused to revolve about a vertical axis. Figs. 1 and 2 illustrate two models due to Penaud, constructed in the early '70s of the 19th century; in the first of these the motive power is obtained from a screw driven by

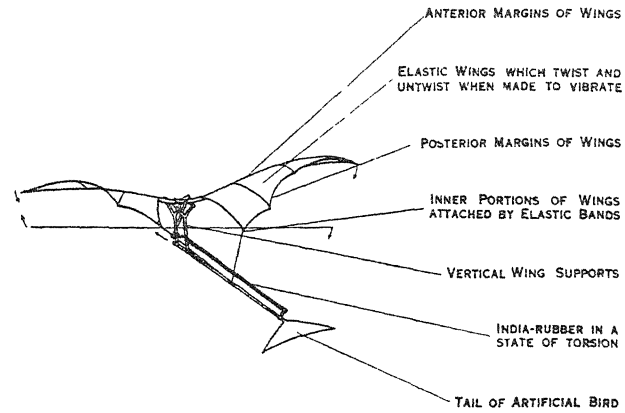



FIG 2.—PENAUD'S SECOND MODEL, WHICH WAS PROPELLED BY A SCREW AND SUSTAINED BY A HORIZONTAL FLEXIBLE WING PENAUD'S SUCCESS OVER OTHER SIMILAR MODELS WAS LARGELY BECAUSE OF THE INVENTION OF WHAT HE CALLED AN AUTOMATIC RUDDER, WHICH WAS A SMALL WING PLACED AFT OF THE MAIN WINGS

the torsion of an India-rubber cord; in the second an attempt is made to imitate the action of a bird's wings. W. S. Henson and J. Stringfellow in 1842 had already constructed models in which the supporting force was obtained from the wings while the motive power came from a screw, and from that time on some of the fundamental principles underlying flight began to be more generally recognized.

**Early Mechanical Machines.**—Early experimenters learned that a flat rectangular plane, when moved edgewise through the air, could develop a vertical "lift" as a result of the pressure of the air on the surface. They also learned that the resistance to forward movement, or "drag," could be overcome by the use of a propeller. If an engine of sufficient power and low weight could be devised, it became apparent that a flat surface, or "wing," could be made to move fast enough through the air to enable it to support the combined weight of the wing, engine and propeller and a human occupant. It was on principles such as these that a steam-engine powered machine was patented by Henson in 1842 and the first steam-powered model was successfully demonstrated by Stringfellow in 1848. Stringfellow, in 1868, exhibited at the Crystal palace a model for which he received a prize of £100. Samuel P. Langley, of the Smithsonian institution of Washington, D.C., worked on similar lines. It had been realized by this time that greater lifting power could be obtained by shaping the supporting surfaces; *i.e.*, by giving them a convex shape on the upper side and a concave on the lower. In 1896 a steam-driven model flew for a distance of about one-half mile along the Potomac river near Washington. At a later date Langley built a large machine which was intended for passengers. It was fitted with a remarkably light steam engine designed by Charles M. Manly and driven by two propellers; this was launched into the air from a vessel in the river. On each of the two occasions in 1903 on which it was tried, something went wrong with the launching arrangements, and the machine was wrecked. Another early machine was that of Sir Hiram Maxim; this too was damaged in a trial in 1894.

**Gliders.**—Meanwhile, it had been realized that before success was reached more knowledge as to the conditions of balance in the air was necessary and, further, that much could be learned by the use of gliders depending for their support on natural air currents.

TABLE I

| Year | Experimenter | Tip to tip (feet) | Surface (square feet) | Weight (pounds) | Pounds per square foot | Speed per hour (miles) | Maximum flight (feet) | Motor | Horse-power | Pounds sustained per horse-power |
|---|---|---|---|---|---|---|---|---|---|---|
| 1879 | Tatin | 6.2 | 7 5 | 3.85 | 0.51 | 18 | 100? | Compressed air | 0.03 | 110? |
| 1885, 1889 | Hargrave (No. 16) | 5 5 | 26 0 | 5.00 | 0 19 | 10 | 343 | " " | 0.06 | 79 |
| 1893 | Phillips | 22 0 | 136 0 | 402 00 | 3 00 | 28 | 500? | Steam | 5.60 | 72? |
| 1894 | Maxim | 50 0 | 4,000 0 | 8,000 00 | 2 50 | 36 | 300? | " | 363.00 | 28 |
| 1896 | Langley | 12 0 | 70 0 | 30 00 | 0 43 | 24 | 4,000 | " | 1.00 | 30 |
| 1897 | Tatin and Ritchet | 21 0 | 86 0 | 72 00 | 0.83 | 40 | 460 | " | 1.33 | 55 |
| 1897 | Ader | 49 0 | 270 0 | 1,100 00 | 4.00 | 50? | 100? | " | 40.00 | 27 |
| 1895 | Lilienthal | 23 0 | 151 0 | 220 00 | 1 46 | 23 | 1,200 | Gravity | 2.00 | 110 |
| 1896 | Pilcher | 23 0 | 170 0 | 200 00 | 1 17 | 25 | 900 | " | 2.00 | 100 |
| 1896 | Chanute | 16 0 | 135 0 | 178 00 | 1.31 | 22 | 360 | " | 2.00 | 89 |
| 1906 | Santos-Dumont | 39 0 | 560 0 | 550.00 | 0.98 | 22.26 | 2,900 | Gasoline | 50.00 | 23 |
| 1908 | W. Wright | 41 0 | 650.0 | 1,100 00 | 1.70 | 37 | 295,000 | " | 24.00 | 46 |

Experimenters, suspended from wings, jumped from natural or artificial heights and allowed the wind to carry them through the air. Otto Lilienthal, in Germany, who first showed the advantage of curving flat surfaces, was killed after making more than 2,000 safe flights in which he endeavoured to maintain his balance by shifting his position relative to the wings. Octave Chanute, in the United States, made the surfaces of the aeroplane movable, and constructed a number of machines.

**The Modern Era.**—Wilbur and Orville Wright, of Dayton, O., began their epoch-making work in 1900 with gliders. They introduced two great improvements: (1) the elevator, or horizontal rudder for steering the machine in the vertical plane, which they placed in front of the main planes (in nearly all modern machines it is attached to the tail); and (2) the flexing of the rear edge of the main planes to vary the lift on either or both at will and thus maintain the balance in the air. A gasoline motor driving a propeller was added in 1903. In 1905 they made 45 flights, in the longest of which they remained in the air for one-half hour and travelled 24½ mi. A little later, 1906, Alberto Santos-Dumont constructed a machine in which he flew a distance of about 250 yd. in 21 sec.

In 1908 Henri Farman, at Issy-les-Moulineaux, Fr., made a circular flight of 1 km. and on Sept. 29 he covered 24½ mi. in 42 min. Meanwhile, the Wrights had continued their work at Dayton. On Sept. 12, 1908, Orville made a flight of 45 mi. in 1 hr. 14⅓ min.; but a few days later he had an accident in which he was seriously injured and his passenger was killed. Wilbur Wright, on Sept. 21, 1908, at Le Mans, Fr., beat all previous records by a flight of 56 mi. in 1 hr. 31 min. 25⅘ sec. On Dec. 31 he remained in the air for 2 hr. 20 min. 23 sec. These great advances had been rendered possible by the improvement of the gasoline engine.

Table I gives some details, approximately correct, of the principal experiments made with flying machines from 1879 to Wilbur Wright's flight in France.

In 1909 a number of notable flights were made, several of them in monoplanes. On July 25 Louis Bleriot crossed the English channel from Calais, Fr., to Dover, Eng., and later H. Latham nearly achieved the same feat. In November Farman covered a distance of about 134¼ mi. in 4 hr. 17 min. 53 sec.

From this time progress in the development of improved flying machines and the accomplishment of record-making achievements was enormous. World War I and the postwar years witnessed the successive progress of aviation as a "wondrous freak," then an implement of destruction in war and finally a useful means of human transportation. The external form of the machine also underwent marked changes from the fragile "boxlike" structure of sticks, paper and wire, through the biplane era of World War I to the sturdy, multiengined, all-metal monoplane transports. The toy models of Henson and Stringfellow were replaced by machines weighing 300,000 lb. or more and having ranges of more than 5,000 mi. Jet-powered fighter aircraft developed shortly after World War II were capable of speeds of more than 500 m.p.h. while research aircraft at mid-20th century had proved the feasibility of human flight faster than the speed of sound. (*See* also TRANS-OCEANIC AND TRANS-CONTINENTAL FLIGHTS.)

## THE SCIENCE OF AERONAUTICS

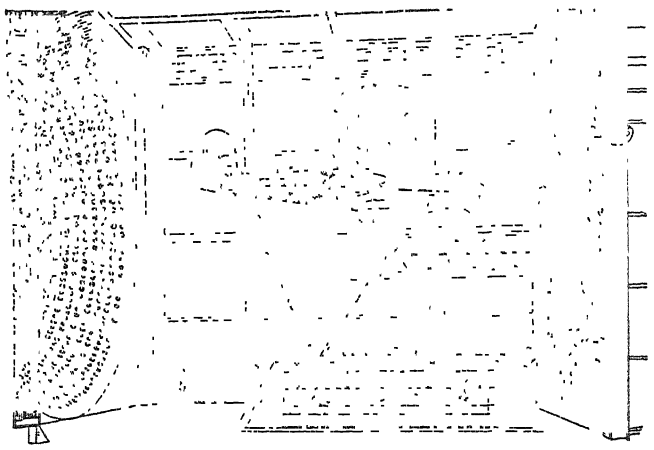
**Early Experiments.**—Even before 1909, the practical beginning of the era of aviation, experimenters had made remarkable progress in understanding the classic principles of fluid resistance and motion The philosophical papers of Sir Isaac Newton (1642–1727), Jean Bernoulli (1667–1748), Jean le Rond d'Alembert (1717–83), Leonhard Euler (1707–83), Osborne Reynolds (1842–1912) and many other physicists advanced fundamental laws of fluid resistance which were basic to modern aerodynamics theories.

Still, much more had to be learned of the laws relating to the flow of air around aeroplanes in motion, the form and shape of aerodynamic bodies, the proper dimensioning, proportioning and location of wings and control surfaces and the most efficient method for propulsion. Experiments in aerodynamics had been made by Langley in 1891. A. F. Zahm at a later date (1902–03) had measured the air velocity, pressure and friction on surfaces of various forms. Sir Thomas Stanton, at the National Physical laboratory, Teddington, Eng., had experimented on the resistance of surfaces in a current of air and the pressure of the wind on plates. F. W. Lanchester, in his *Aerodynamics,* had described similar measurements. Lord Rayleigh, in various papers of great importance dating from 1876, had discussed questions of the resistance of fluids and in 1899 contributed to the Manchester *Memoirs* a paper on the mechanical principles of flight; but no organized attack on the questions raised by the flight of a body heavier than air had been made.

**Government Sponsorship of Aeronautical Research.**—As early as 1909 governments recognized the importance of concerted and co-ordinated effort in the field of aeronautical research to maintain leadership in aviation. England in 1909 established at the National Physical laboratory an advisory committee for aeronautics. Work of a similar character was in progress elsewhere; in Germany at Göttingen, under L. Prandtl; in Russia at Koutchino, where D. Riabouchinsky was director. In the United States on March 3, 1915, congress established the National Advisory Committee for Aeronautics (NACA) for the supervision and direction of the scientific study of the problems of flight. From the laboratories of these nations came scientific data upon which aeronautical engineers came to rely for the design of new planes.

**The Wind Tunnel.**—In studying the forces to which aircraft are subject in flight, mathematics alone is of little help; the dynamics of the air are too complex for reliable results and recourse must be had to experiment. To carry a given weight, how large must the wing be; what speed, shape, angular setting, etc., is needed? How should body and tail surfaces be placed, shaped and positioned for best results? How can speed, range, controllability and stability be predicted accurately prior to construction to ensure satisfactory results? Such are some of the questions of aerodynamicists. These and many others are quickly answered by testing models in a wind tunnel.

Wind tunnels are designed to produce a high-speed, steady flow of air through the test section, or throat, where the model is located. Thus, instead of passing through the air as does the full scale aeroplane, the model is stationary, with the air stream pass-



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FIG 3.—THE 24-FT WIND TUNNEL AT THE ROYAL AIRCRAFT ESTABLISHMENT, SHOWING AEROPLANE IN POSITION ON MAIN BALANCE

ing over it, making it relatively easy to explore the airflow streamlines over the model and measure its lift, drag and balancing forces. The model is also arranged so that it can be pitched to various angles with relation to the horizontal air stream; for airfoils this angle is known as the angle of attack.

Wind tunnels are of various kinds, shapes and sizes; small tunnels testing models of approximately ten-foot span at 100 m.p.h. air speeds are available at most aeronautical engineering institutions. Large-scale, subsonic and supersonic speed wind tunnels are mostly available only to government laboratories because of the cost of construction and operation. (*See* also AERODYNAMICS.)

Measurements of model forces in wind tunnels, lift ($L$), drag ($D$), moments ($M$) and centre of pressure ($C.P.$) are usually determined for a complete range of angles of attack and are plotted in the form of airfoil characteristics charts; these are of utmost importance to the aerodynamicist in calculations of the full-scale aeroplane. (*See* Fig. 4.)

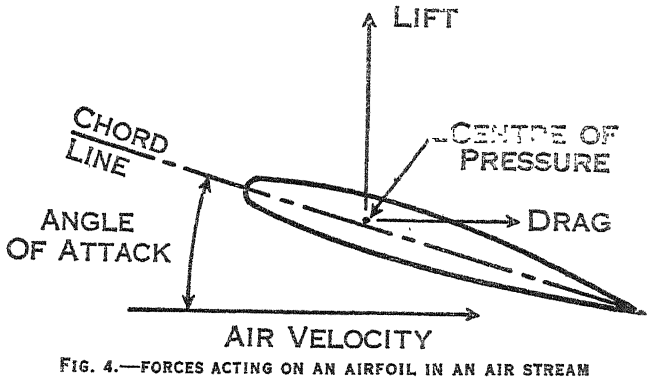



FIG. 4.—FORCES ACTING ON AN AIRFOIL IN AN AIR STREAM

**Airfoil Characteristics.**—"Airfoil section" is the technical name given to the curved-surface cross section of the wing. Its length is the chord ($C$); the width is its thickness ($t$). Airfoil sections have a long history of development from the early flat plate to the modern efficiently cambered sections. Fig. 5 shows the evolution of airfoils.

Variation of shape, curvature of upper and lower surfaces, thickness, shape of nose and trailing edge, all have important and varying effects on the lift, drag, moment and airflow over the wing. For slow-speed planes of 150 m.p.h. or less, thicker sections offer good lift at high angles of attack and permit low landing speeds. They also have ample space for light-weight internal structures. High-speed planes need thinner wings for low drag. Specially designed thin, sharp, nose sections are desirable for supersonic speed planes to offset air compressibility shock problems.

So long as the angle of attack remains constant, the lift, drag and moment are approximately proportional to the product of the density of the air, the square of the speed and the area of the wing on which it acts; so we may write:

$$L = C_L \rho / 2 S V^2$$
$$D = C_D \rho / 2 S V^2$$
$$M = C_M C \rho / 2 S V^2$$

where $C_L$, $C_D$ and $C_M$ are known as airfoil aerodynamic coefficients; $\rho$ is the air density (at sea level 0 002378 slugs per cubic foot), $S$ the area of the wing and $V$ the air speed.

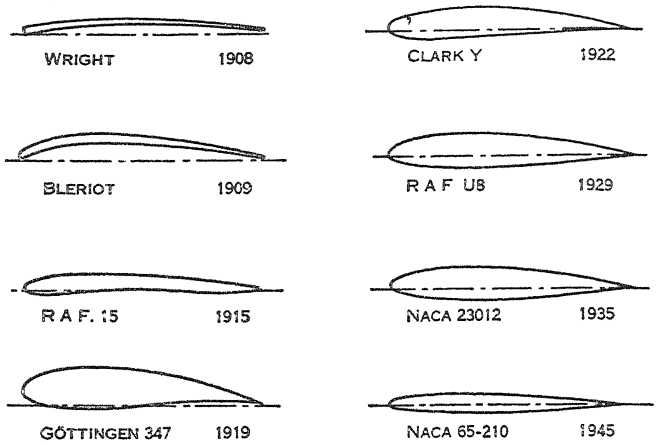



FIG. 5 —EVOLUTION OF THE MODERN AIRFOIL SECTION

From the wind-tunnel balances $L$, $D$ and $M$ are measured for a range of angles of attack; the three coefficients can then be calculated from the three equations. The results are then plotted in the form of curves, known as airfoil characteristics charts, an example of which is shown in fig. 6.

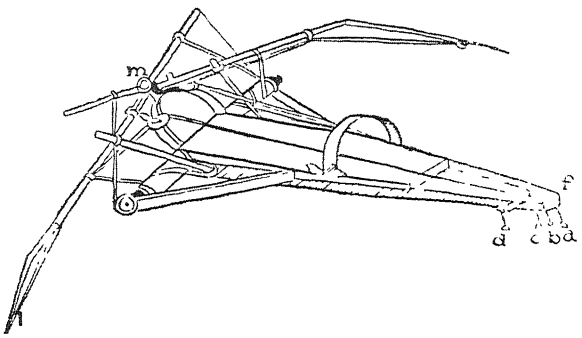
It is from curves such as these that the weight, speed and other performance characteristics of the aeroplane are computed.

**Scale Effect.**—Before applying wind-tunnel model data to a full-scale plane, scale effect corrections are necessary. Since the full-scale plane may be from ten to many times larger than the model, and since air speeds may be three times or more greater, and air density can vary, how can one step from wind-tunnel results to the actual plane? Dimensional theory shows that, compressibility aside, equivalent conditions are met if $VL\rho/\mu$ (called Reynolds number) of the model and full-size body are equal; where $V$ is the air speed; $L$ is a convenient linear dimension; $\rho$ is the air density and $\mu$ the viscosity coefficient of air. Practically this means that since the model is small, the wind-tunnel test speed must be proportionally increased; for a one-tenth scale model a speed of about ten times the plane speed would be needed. This is impractical but the situation is easily remedied by the application of empirical corrections obtained from a series of tests run on other comparable bodies at varying Reynolds numbers. When such corrections are made to the drag curve, the slope of the lift curve and the maximum lift coefficient, it can be said that conditions for the full-size plane have been met.

**Compressibility Effects.**—As air speeds increase to more than 400 m.p.h., wind-tunnel data must be further corrected for the change in air density resulting from its being compressed at such speeds. The magnitude of corrections needed increase with the ratio $V/v$ (called Mach number, $M$); where $V$ is the plane speed and $v$ is the speed of transmission of sound in air. Experiments show that lift curve slope increases, maximum lift decreases and drag coefficients rise rapidly as the Mach number approaches 1.

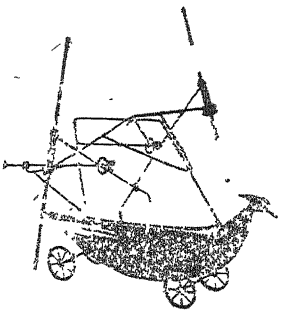
At the speed of sound, or $M = 1$, tremendous changes occur to the conditions of airflow around airfoils and bodies. This is called the sonic region. Compression shock waves originate at this speed which produce tremendous changes of lift, drag and moment. By mid 20th century no mathematical theories had yet been developed to predict accurately the exact effects; recourse was made to sonic and supersonic wind-tunnel testing.

**Stalling and Spinning.**—From Fig. 6 it will be noted that as the angle of attack of the airfoil increases, a point is reached where the lift coefficient, $C_L$, suddenly falls; at this instant the plane can no longer maintain flight; its wings lose lift and it must pitch





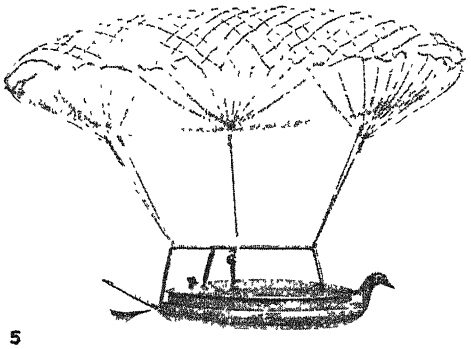

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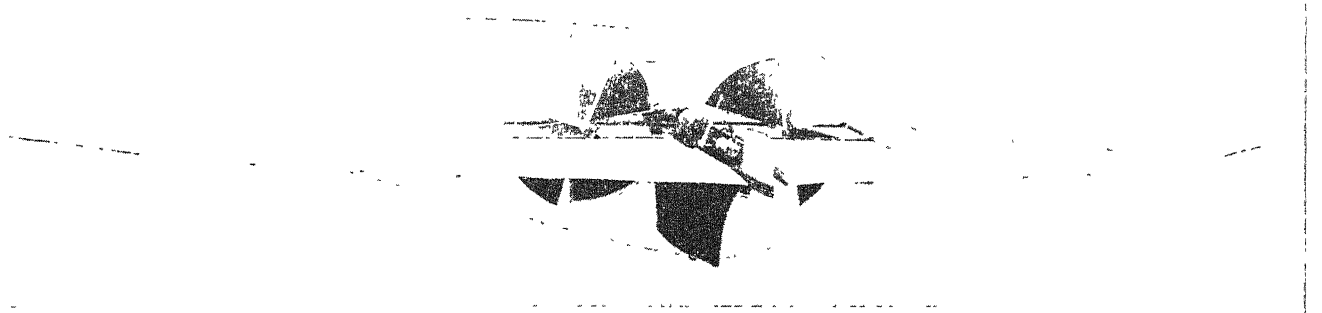
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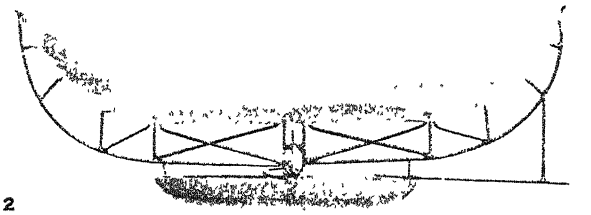
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## EARLY DEVICES OR PLANS FOR FLYING MACHINES, 1500 to 1843

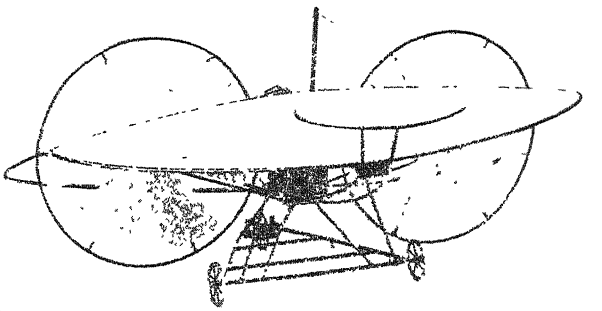
1. Leonardo da Vinci's conception of a flying machine 1500. The wings or "oars" were to be operated by a system of stirrups or pulleys
2. Francesco de Lana's flying boat, conceived about 1650. The plan was to attach a boat with sails to four large copper balls from which the air had been exhausted
3. Combination of helicopter and aeroplane planned in 1809 by Sir George Cayley, spoken of as the father of British aeronautics
4. The "Eagle," designed by Comte de Lennox in 1834 in collaboration with Le Berrier; dimensions 130 feet by 35 feet with a lifting power of 6,500 pounds
5. Hand-driven propeller type navigable balloon experimented with in 1816 by Sir George Cayley
6. Henson's "Aerial" steam carriage, designed in 1842. The extensive supporting structures occupied a nearly horizontal position, and it was equipped with a 25-h.p. steam engine, but it never left the ground

# AERONAUTICS

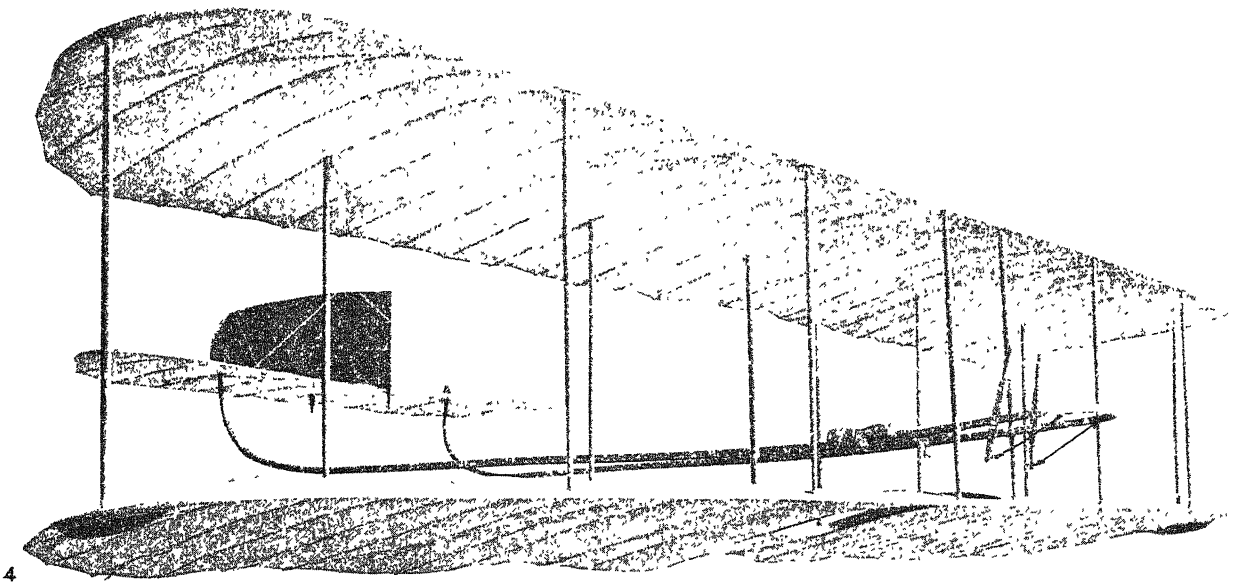




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## NINETEENTH CENTURY EXPERIMENTAL NAVIGABLE BALLOON AND AEROPLANES

1. Stringfellow's aeroplane, built in 1848, the first model aeroplane to fly
2. Bell's patent locomotive navigable balloon, 1850; an early attempt at a semi-rigid dirigible with two hand-driven propellers
3. Thomas Moy's Aerial Steamer, 1874, which was fitted with a 3 h.p. steam engine but succeeded in rising only a few inches from the ground
4. Chanute's Glider, 1903. In experimenting with this and other forms of engineless aeroplanes, Octave Chanute made over a thousand glides without accident

downward with the sensation of falling; it is said to be stalled. All airfoils have this common fault. The violence of the stall, the behaviour of the plane immediately after stalling and the recoverability afterward are of extreme importance. From his knowledge of the shape of the lift curve, the engineer can properly proportion the wing, design twist into the wing, shape the wing tips, sweep the wing and provide stall-warning characteristics as needed to obtain the right stalling performance.

Since a large proportion of accidents arise from stalls close to the ground a well-designed plane will develop an unmistakable warning buffet, or shake, just preceding the stall; it will stall with the nose pitching downward only slightly so that very little altitude is lost and it will not roll to one side or go into a spin. Such a plane is known as "spinproof"

Spins occur after wing stall is reached if the plane is allowed to fall off and roll at the same time. Quickly thereafter it develops into a steady gyrational descending motion about a vertical axis of rotation somewhere ahead of the nose. Altitude is lost rapidly and recovery from the spin must be quickly effected to avert a crash. Many such accidents did occur until it was learned that proper positioning of tail surfaces, their shapes, sizes and locations of control surface were important for good spin-recovery characteristics. Planes can be so designed that they can be pulled out of a spin by simply centring all controls; when rotation ceases, recovery is completed by pulling out of the dive attitude which follows.

**Landing Speed.**—The plane must, on approach to a landing, be slowed down by increasing the wing angle of attack; this is done by pulling back on the elevator control, thus raising the nose. The slowest speed at which the plane can maintain steady flight in this approach is called the landing speed. This speed can be computed from the equation:

$$V \text{ min.} = \sqrt{\frac{2}{\rho C_L \text{ max.}}} \times \frac{W}{S}$$

where $C_L$ max. is the maximum airfoil lift coefficient and $W/S$ is the wing loading; *i.e.*, weight divided by wing area.

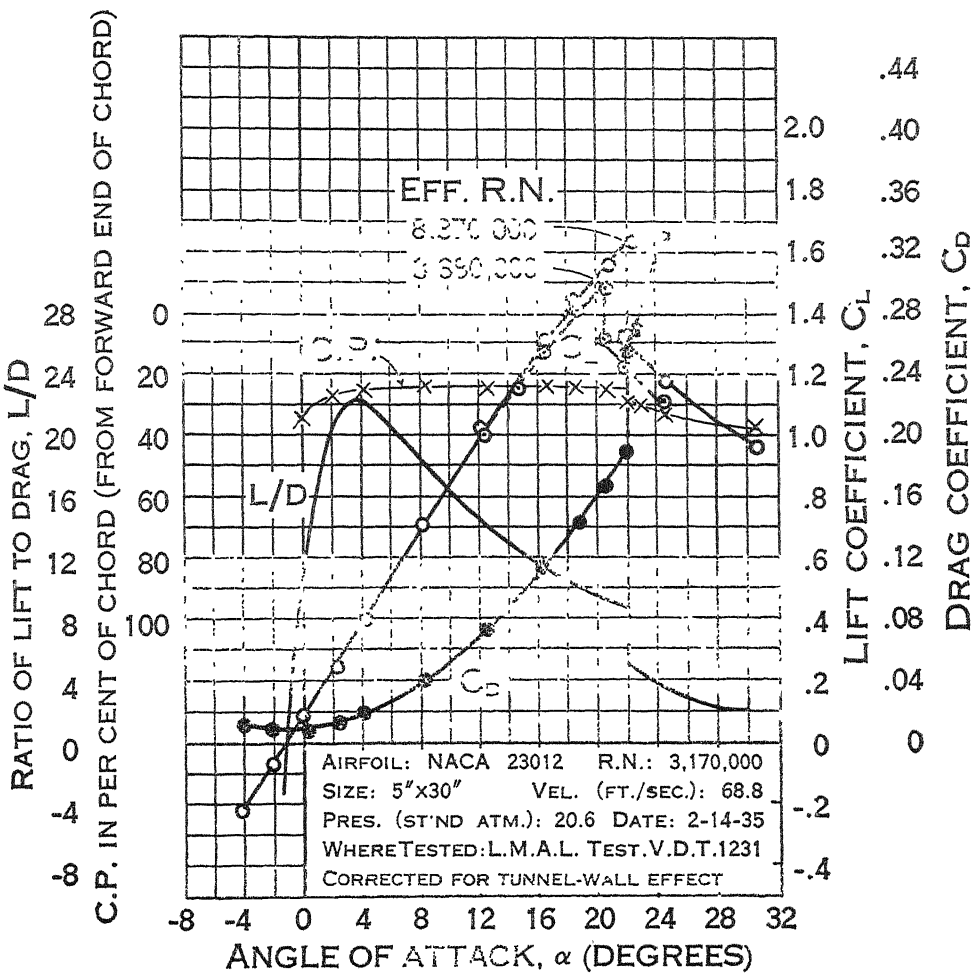
It is desirable to have $V$ min. as low as possible for safety reasons; for a conventional light plane where $C_L$ max. is 1.35 and $W/S$ is 12 lb. per square foot the landing speed would be 59 m.p.h.

Reduction of landing speed to a lower value is possible only if $W/S$ is decreased (*i.e.*, decrease the plane's weight or increase the wing area) or $C_L$ max. is increased. The latter is the more feasible, through three means: (1) use of leading edge slots; (2) use of trailing edge flaps; and (3) energizing or removing the layer of air on the top surface of the wing by what is termed boundary layer control. The trailing edge flap is most familiar; however, all these methods, in common, delay the breakdown of airflow over the wing at the normal stall angle so that much higher values of $C_L$ max. can be achieved.

A flap added to the wing of the example above could develop a $C_L$ max. of 2.0 with a resultant drop in landing speed to 48 m.p.h.

**Performance.**—Similarly, other important characteristics of the plane can be computed by using fundamental aerodynamic laws. Space does not permit going into all of these, but a few of the more important performance characteristics so determined are mentioned.

*Speed*—Engine thrust must overcome the total drag of wing, struts, body, tail surfaces, etc. The maximum speed can be computed by equating the power available from the engine to the power absorbed to overcome total drag.




BY COURTESY OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

FIG. 6—AIRFOIL CHARACTERISTICS OF NACA 23012 AIRFOIL, SHOWING THE EFFECT OF SCALE ON MAXIMUM LIFT COEFFICIENT AS SHOWN BY CHANGE IN THE REYNOLDS NUMBER

*Climb and Ceiling.*—The excess of power available from the engine over that required for level flight at a particular speed is the amount of energy available for climb, which is the rate at which the altitude is increased, expressed in feet per minute. As the altitude is increased, the rate of climb decreases; at that altitude where it becomes zero, the absolute ceiling of the aeroplane is said to have been reached.

*Range.*—Range can be determined by computing the power required for the given speed of flight times the engine specific fuel consumption (pounds per horsepower per hour) and the quantity of fuel available.

**Stability.**—It is well to consider what is meant by stability as applied to an aeroplane. Imagine that by some means—a sudden downward gust, for example—the motion of the plane is disturbed and the nose takes a downward direction.

If the pilot does nothing to counteract this, one of two resulting actions will occur. In a properly designed aeroplane the nose will automatically rise and after a few successively decreasing pitching oscillations it will, since it is stable, resume level flight of its own accord. Any disturbance in roll or yaw will similarly die out. On the other hand, an unstable machine will increase in oscillation, the nose rising and falling in in-

creasing amplitude, to such an extent as to become dangerously violent. It is not possible here to discuss the conditions necessary for stability; this requires a knowledge of a number of quantities known as stability derivatives which can be determined by suitable experiments in a wind tunnel.

An inherently stable plane will, when set on a course, try to keep it; this is an important characteristic since, lacking stability, safety is impaired, accurate navigational and blind flying impossible and strain of flying on the pilot intolerable.

## THE AEROPLANE

As treated herein, classification and subdivisions under important subject headings are a necessary preliminary for an adequate and brief presentation of the science of design, use and operation of aeroplanes. The separate article AEROPLANE contains a detailed account of many essential design considerations, including flight and performance features.

**Components.**—The essential components of all aeroplanes are: (1) wings or lifting surface; (2) stabilizing and control surfaces; (3) fuselage, or body, housing occupants; (4) propulsion system, engines and propellers; (5) landing gear (*i e.,* wheels, skiis, watertight hulls or seaplane floats); and (6) equipment, instruments and control devices.

The *wings* support the machine. They are carefully designed for minimum aerodynamic drag, good stalling characteristics (*see* above), low landing speeds and use of efficient light-weight structural materials. Steady motion in flight is achieved by a vertical tail surface (*fin*), a horizontal tail surface (*stabilizer*) and the effective *dihedral* angle of the wings. Small hinged planes, operable by the pilot, are attached to the rearward edges of these areas to obtain controllability: a *rudder,* attached to the fin, which guides the aeroplane horizontally; an *elevator,* which causes the craft to dive or climb, attached to the horizontal stabilizer; and *ailerons,* which produce a rolling motion of the craft by changing the angle of the incidence of the wing and are hinged along the rear edge of the wing. When moved, the aileron causes a loss or gain in lift on one wing with respect to the other, thereby allowing the pilot to rock the plane at will. The *fuselage* housing the pilot and passengers is most frequently a shell-like structure resembling an elongated streamline body. It contains the pilot's *cockpit,* which includes all flight and engine controls, radio, instruments and navigation equipment.

The propulsion system (see *Aircraft Propulsion,* below) provides thrust to overcome air drag and thus achieve forward speed.

*Landing gears* are essential for take-off and landing purposes. On land- and amphibian planes they usually consist of wheels and tires mounted at the end of extensible shock-absorbing struts. To reduce air drag it is customary to retract landing gears into the body or wings in flight. On flying boats and seaplanes the bottom surface of the landing structure is carefully shaped and proportioned to provide good hydrodynamic characteristics as regards handling and control characteristics, absence of tendency to porpoise and minimum "hump" speed; *i.e.,* that speed where the hull rises in the water, its resistance drops rapidly and skimming on the water surface is started.

**Types of Aeroplanes.**—Aeroplanes are customarily described with reference to operational use, wing arrangement, propulsion means, type of landing gear, etc.

*Landplanes* operate from airports, *seaplanes* and *flying boats* from sheltered water areas; *amphibians* operate from either water or land but have retractable landing wheels making it possible for the pilot to take off and land on water or an airfield. Skiis are sometimes installed on landplanes to convert them to *skiplanes* for operation on snow and ice. *Tricycle*-type landplane landing gears have a front wheel located on the nose of the fuselage, allowing the aeroplane to remain in a level attitude on the ground. A *tail-wheel*-type aeroplane uses a wheel at the tail end of the fuselage requiring the plane to be in a "tail-low" attitude while at rest.

Aeroplanes with one main wing are called *monoplanes;* two wings, one above the other, *biplanes.* A tailless monoplane is called a *flying wing* *Canard* monoplanes have the tailplane ahead of the main wing. The location of the monoplane's wing vertically with respect to the fuselage designates it as a *low-wing, mid-wing* or *high-wing,* the mid-wing having the wings so attached to the fuselage as to seem to pass approximately through the middle

Aeroplanes are either *propeller driven* or *jet powered* Single-engine planes have one engine, usually in the nose of the fuselage Multiengined aeroplanes employ two or more engines, disposed symmetrically on each side of the fuselage.

**Development and Utility.**—Space permits only a brief treatment of some major factors governing the development and use of modern aeroplanes Four essential elements are considered (1) safety; (2) speed and comfort; (3) reliability of service; and (4) special purpose. A discussion of each follows.

*Safety.*—Aeroplane designers are acutely conscious of safety requirements, calculations and thorough strength testing of all structural components are conducted for the maximum possible air and landing loads. Numerous tests are made of power plants, control systems, instruments, pressurization systems, fire detection and control procedures, etc. Finally, thorough flight tests are completed to prove the safety and reliability, even to the extent of simulating emergency conditions such as failure of vital control systems, loss of engines and entry into icing conditions.

Air-line operators also have thorough training and check-up programs to ensure the competence of pilots, flight engineers, navigators and mechanics. A continuous system of inspection, overhaul and replacement of critical components of the plane is maintained.

*Speed and Comfort.*—Higher operational speeds are sought, without sacrificing economy of fuel and sizable pay load. To do this, care is used in selecting the engine and propeller; thin wings and well-streamlined smooth bodies and surfaces are used to obtain minimum drag. Equipment must be compactly stored within the structure. Since low landing speeds are needed, high lift flaps are placed on wings to reduce the stalling speed.

Comfort and safety of passengers is achieved through pressurized cabins, high-altitude flying in smooth air, soundproofed compartments, comfortable chairs, safety belts and many other features.

*Reliability of Service.*—Reliability of modern aircraft engines, structures and equipment is such that delays to scheduled trips resulting from mechanical difficulties are rare. Poor visibility and bad meteorological conditions of storms and icing, however, were still real handicaps at mid-20th century. "All-weather" equipped aeroplanes and a world-wide system of aerial highways using radio devices for guiding pilots (and later automatically directing aircraft) were being developed. Blind flying instruments for control and trim as well as ice-removal equipment to keep engines, propellers and wings free of ice had become essential. Radio beams and electronic instrument landing systems were available to guide aircraft and make possible safe landings with cloud ceilings of 200 ft. and visibility of one-fourth mile.

*Special Purpose.*—Aeroplanes are designed to accomplish definite tasks, such as transportation of people and cargo, aerial survey and mapping, agriculture and forestry uses and military applications. The form, arrangement of body, proportioning of wings and control surfaces, number of and type of engines, are all dictated by the ultimate purpose of the particular design. People must be enclosed in comfortable heated and ventilated compartments. Cargo must be carried in compartments having large external openings and heavy floor structures. Camera installations and clear-view windows must be provided for aerial mapping work. Dispensing hoppers and spray equipment are specially designed for use in aerial-seeding and pest-control planes. Military aircraft have special design requirements of high strength for manoeuvrability at high speeds and extreme altitudes; bombers, fighters, training, observation and liaison planes all are designed under specialized requirements to make them suited for specific use.

**Private Planes.**—Great improvements were made in the design of small planes to accomplish low landing speeds, eliminate stalls and spins, simplify flying by use of two controls (*i.e.,* elimination of the rudder and use of a wheel for elevator and aileron control) and improve landing gears to simplify ground taxiing by use of a steerable tricycle landing gear. Research was undertaken to im-

TABLE II —*Data on Modern Aircraft*

| Aeroplane | Type | Seats | | Power plant | Speed | | Altitude (feet) | Normal range (miles) | Rate of climb (ft per min at S L) | Service ceiling (feet) | Fuel capacity (gallons) | Weight (pounds) | | Dimensions (feet) | | | Wing area (square feet) | Wing Loading | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Crew | Others | | Max m p h | Cruise m p h | | | | | | Gross | Empty | Span | Length | Height | | (lb per sq ft) | (lb per h p) |
| Piper Cub | Single-engine cabin | 1 | 1 | 65-h p Continental | 112 | 100 | Sea level | 350 | 510 | 13,250 | 12 | 1,220 | 574 | 35 208 | 22 29 | 6 625 | 178 5 | 6 83 | 18 77 |
| Ercoupe | Single-engine cabin | 1 | 1 | 75-h p Continental | 120 | 105 | Sea level | 450 | 530 | 11,100 | 24 | 1,400 | 800 | 30 0 | 20 167 | 6 16 | 142 6 | 9 83 | 18 70 |
| Navion | Single-engine cabin | 1 | 3 | 185-h p Continental | 163 | 155 | Max at sea level Cruise at 3,500 | 500 | 730 | 12,000 | 39 5 | 2,750 | 1,673 | 33 4 | 27 8 | 8 54 | 184 34 | 14 82 | 11 87 |
| Douglas DC-3 | 2-engine transport | 3 | 25 | 2-1,200-h p Wright | 227 | 195 | Max at 7,500 Cruise at 7,500 | — | 890 | 21,000 | 822 | 24,000 | 16,398 | 95 0 | 64 5 | 16 92 | 987 0 | 24 3 | 10 0 |
| Douglas DC-6 | 4-engine transport | 4 | 56 | 4-2,100-h p Pratt & Whitney | 358 | 315 | Max at 19,600 Cruise at 20,400 | 2,350 | 1,160 | — | 4,248 | 95,200 | 54,325 | 117 5 | 101 5 | 28 5 | 1,463 0 | 63 7 | 11 1 |
| Convair 240 | 2-engine transport | 3 | 40 | 2-2,100-h p Pratt & Whitney | 336 | 291 | Max at 13,500 Cruise at 16,000 | 625 | 1,475 | — | 1,000 | 40,500 | 26,531 | 91 75 | 74 6 | 26 9 | 817 2 | 47 7 | 9 28 |
| Grumman G-73 | 2-engine amphibian | 2 | 8 | 2-600-h p Pratt & Whitney | 215 | 180 | Max at 8,000 Cruise at 8,000 | 627 | 1,190 | — | 380 | 12,500 | 8,773 | 66 67 | 48 33 | 18 75 | 414 0 | 28 75 | 10 63 |
| Beech Model 18S | 2-engine transport | 2 | 8 | 2-450-h p Pratt & Whitney | 230 | 212 | Max at 5,000 Cruise at 10,000 | 1,500 | 1,180 | 20,600 | 202 | 8,750 | 5,817 | 47 58 | 34 0 | 9 21 | 340 0 | 25 1 | 9 72 |
| Lockheed Constellation L-649 | 4-engine transport | 4 | 56 | 4-2,200-h p Wright | 350 | 300 | Max at 19,200 Cruise at 21,000 | 4,800 | 1,465 | — | 4,600 | 94,000 | 56,000 | 123 0 | 95 25 | 23 0 | 1,650 0 | 57 0 | 9 4 |
| Boeing 377 Stratocruiser | 4-engine transport | 4 | 86 | 4-3,500-h p Pratt & Whitney | 375 | 300 | Max at 25,000 Cruise at 25,000 | 4,600 | 1,060 | — | 4,500 | 142,500 | 82,000 | 141 0 | 110.3 | 38 25 | 1,769 0 | 80 5 | 10 2 |
| Sikorsky S-51 Helicopter | 3-blade single rotor | 1 | 3 | 450-h p Pratt & Whitney | 103 | 85 | Sea level | 255 | 1,000 | 14,100 | 100 | 5,500 | 1,505 | — | 41 17 | 12 92 | 1,805 0* | 3 05† | — |
| Bell 47 Helicopter | 2-blade single rotor | 1 | 1 | 178-h p Franklin | 92 | 85 | Sea level | 212 | 700 | 8,500 | — | 2,200 | 1,482 | — | 30 42 | 8 37 | 970 0* | 2 26† | — |

*Area swept by main rotor. †Blade loading

prove the speed range; *i e*, increase cruising speeds to more than 150 m p.h and reduce landing speeds to less than 50–60 m p h. Combination aeroplane-automobiles, in which wings could be detached, were also designed.

The fuselage structure of most modern private planes is either of welded steel tubing covered by painted or doped fabric or of riveted thin sheet aluminum alloy construction. Plywood and spot-welding metal construction have also been used Wings may be constructed of wood or metal spars. Internally, ribs of a truss shape are attached, having the form of the wing airfoil The complete structure is covered with doped fabric sewn to the ribs, or a thin sheet, or skin, of aluminum. In single-engine aircraft, small four- to six-cylinder air-cooled engines of approximately 100–150 h p. are used, requiring 6–12 gal. of fuel per hour to operate. Propellers may be of wood or metal.

**Commercial Air-Line Planes.**—Table II includes general information on some of the most familiar air-line transport aircraft at mid-20th century. Approximately five years of intensive engineering development and testing are required to produce a successful modern transport. Since economic competition exists with railroads, buses and ships, low operating costs per mile flown are essential. Pay load (number of passengers or weight of cargo) must be as high as possible.

Special emphasis is given in design to safety aspects of structure, power plants, equipment and radio components. Multi-engines are desired to ensure safe arrival at emergency landing fields in the event of failure of one or more engines. Special procedures to detect and extinguish fires are developed. Automatic pilots and other controls, and thermal heating of wings and vulnerable icing areas are provided to make flying safer and easier Hydraulic, electrical and mechanical controls, equipment and instruments are duplicated for safety reasons. To shorten landing runs and conserve brakes, reversing pitch propellers are employed.

## ROTATING WING AIRCRAFT—GYROPLANES, HELICOPTERS

For centuries inventors had sought to develop wingless heavier-than-air flying machines using the principle of horizontally rotating propellers or the like. The attractive possibility of achieving hovering flight, a distinct advantage over fixed-wing aeroplanes which require long runways for take-offs and landings, stimulated inventors, but failures were the rule until about 1920, primarily because engines of sufficient power and low weight were unavailable.

**Gyroplane.**—In the 1920s, in Spain, Juan de la Cierva created the Autogiro, a strange-looking machine somewhat like a monoplane with a four-bladed rotor mounted on a central pylon and rotating horizontally above the fuselage. The engine-propeller installation on the front of the fuselage operated as on a conventional aeroplane. The lifting power of the rotor, which supported the aircraft in the air, was derived solely from the motion of the blades of the rotor as it moved edgewise through the air. The rotation was automatically achieved as a result of the air's passing upward past the individual blades, creating, in part, on each a horizontal, forward-acting force which tended to increase the rotational speed of the blade; hence, the terms "autorotation" and "autogiro."

This principle was exploited in various gyroplane developments with moderate success by later inventors in the United States and England. However, the advantages of these craft over conventional aeroplanes, particularly with respect to load-carrying ability, power requirements and speed, were insufficient to ensure commercial acceptance. More important, gyroplanes, incapable of hovering flight, were overshadowed by the advent of the helicopter.

**Helicopter.**—This type of aircraft is characterized by one or more horizontally rotating rotors directly driven by the aircraft engine. It has no wings. In free flight it can move at will in three dimensions: vertically, forward or backward, and sidewise. Each rotor usually consists of two, three or four separate blades extending radially from a central axis of rotation, or hub. The angle of attack of each blade can be changed at will by the pilot through movement of either of two levers, called the "collective

TABLE III.—*Data on Modern Aero Reciprocating Engines Developed in the U S*

| Make and model | Type | Take-off rating | | Min fuel consumption at cruising power (lb per h p per hr) | Cylinders | | | | Weight (lb per max h p) |
|---|---|---|---|---|---|---|---|---|---|
| | | h p at r p m at sea level | B M E P psi* | | Number | Bore and stroke (inches) | Displacement (cubic inches) | Compression ratio | |
| Continental A-65-8 | Horizontally opposed | 65/2,300 | 131 | 48 | 4 | 3 87x3 62 | 171 | 6 3 1 | 2 6 |
| Lycoming O-235-C | " | 100/2,600 | 130 | 52 | 4 | 4 37x3 87 | 233 | 6 2 1 | 2 1 |
| Franklin 6A4-165-B3 | " | 165/2,800 | 139 | 50 | 6 | 4 5x3 5 | 335 | 7 1 | 1 7 |
| Jacobs R-755-A1 | Single-row radial | 300/2,200 | 143 | 43 | 7 | 5 25x5 0 | 755 | 6 1 | 1 7 |
| Pratt & Whitney Wasp, Jr, B-5 (R-985) | " | 450/2,300 | 157 | 46 | 9 | 5 18x5 18 | 985 | 6 1 | 1 5 |
| Pratt & Whitney Twin Wasp D-5 (R-2000) | 2-row radial | 1,450/2,700 | 211 | .43 | 14 | 5 75x5 5 | 2,004 | 6 5 1 | 1 09 |
| Pratt & Whitney Wasp Major, TSB3-G (R-3350) | 4-row radial | 3,500/2,700 | 235 | .44 | 28 | 5 75x6 0 | 4,363 | 6 7 1 | 99 |
| Wright Cyclone C18BD (R-3350) | 2-row radial | 2,500/2,800 | 211 | .43 | 18 | 6 12x6 31 | 3,348 | 6 5 1 | 1 2 |

*Brake mean effective pressure, pounds per square inch

pitch control" and the "cyclic control." Movement of the collective pitch lever results in the helicopter's ascending or descending; the cyclic control changes the plane of rotation of the rotor in the direction desired by the pilot—thus controlling forward, rearward and sideward motion.

One serious engineering problem concerns the counteraction of the engine torque force reaction arising from driving the rotor; unless counteracted by an oppositely applied torque capable of being varied by the pilot at will to suit the complete range of engine power, the effect would be to rotate the helicopter body in an opposite sense of the rotor rotation. A small auxiliary tail rotor, similar to the aeroplane propeller, mounted vertically on the rear of the fuselage and driven by a long drive shaft from the engine, is commonly used on single main rotor-type helicopters to provide antitorque forces. The tail rotor incorporates a blade, variable pitch-control mechanism operable by the pilot using conventional rudder pedals; the pilot can thus rotate the helicopter completely through 360° by this means while hovering. When more than one main rotor is used on the helicopter, such as in tandem, coaxial and other multirotor arrangements, the unfavourable engine torque effect can be effectively eliminated by causing each rotor to rotate in opposite directions.

Helicopter rotors are designed to continue rotation automatically in the event of engine failure, permitting safe descent and landing in small areas. This feature plus good speed range from zero to much more than 100 m.p.h., good lifting or pay load capacities and ability to operate from small areas, even rooftops, made the helicopter suitable for aerial taxicab and short-haul operations.

## AIRCRAFT PROPULSION

Early attempts to fly failed or met with poor success because of inadequate knowledge of the power necessary and the lack of suitable engines. Steam was used by Phillips (1842), Henson (1842) and Stringfellow (1848) to drive models. Manly developed a small steam engine of 60 oz. which developed one horsepower; the four boilers weighed 7 lb. each. He later built the 52-h.p., five-cylinder gasoline engine used by Langley (1903). In 1894 Maxim devised a pair of two-cylinder compound engines, each weighing 600 lb. and giving 363 h p.

Steam power was then dropped and the problem changed by improvements in the internal combustion engine burning gasoline Santos-Dumont (1906) used a light and (for the time) powerful gasoline engine; about one year later Farman used an eight-cylinder Antoinette engine developing 40 h p. at 1,100 r.p m.

In 1908 Wilbur Wright, in his notable flights in France, employed a four-cylinder gasoline engine of 24 h p., making 1,200 r.p.m. and connected by chain gearing to two wood propellers which revolved at 450 r.p.m. The weight of the motor was stated to be 200 lb.

From this time on progress was rapid. At first engines cooled by liquids, water or Prestone were used extensively but being heavy, and susceptible to failure because of leaks, were dropped in favour of air-cooled types.

Modern air-cooled aircraft radial engines of the reciprocating type were perfected to the point that power outputs of one horsepower per pound and fuel consumptions of 0.45 lb. per horsepower per hour became ordinary. Powers of from 50 to 3,500 h.p. were available. (*See* AERO ENGINES for other details.)

**Types of Engines.**—Aircraft engines were perfected along the following general lines: (1) reciprocating engines; (2) gas-turbines (turbojets) and (3) other reaction engines. Tables III and IV present typical characteristics of the first two types. Turbojets are also a form of reaction engine.

Reciprocating engines employ cylinders with moving pistons which, under the pressure of exploding fuel-air mixtures in the cylinders, rotate a crankshaft to produce power. Engines with cylinders located behind one another are called "in-line" engines. Radial engines have the cylinders disposed in a circle radially from the crankcase. The radial engine has the advantage of short length and compactness but presents a problem because of its large frontal area, requiring careful cowling to reduce drag and provide cooling.

Gas-turbine engines were a development of World War II. They consist of three essential components: (1) a compressor to

TABLE IV.—*Data on Gas-Turbine Engines*

| Make | Compressor | | Combustion chamber | Turbine | | Size and weight | | | | Performance | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | Stages | | Flow | Stages | Length (inches) | Diameter (inches) | Frontal area (square feet) | Weight (pounds) | Take-off thrust (pounds) | Revolutions per minute | Fuel consumption at cruise (lb. per lb. thrust per hr) |
| Allison 450-D4 | Axial | 11 | 8, tubular | Axial | 1 | 146 | 37 0 | 7 5 | 2,260 | 4,900 | 7,800 | 1 06 at 2,890 |
| General Electric TG-190B | Axial | 12 | 8, tubular | Axial | 1 | 144 | 36 7 | 7 35 | 2,525 | 5,000 | | 1 056 at 2,930 |
| Westinghouse 24C | Axial | 11 | Annular | Axial | 2 | 120 | 28 0 | 5 16 | 1,250 | 3.200 | 12,500 | 1 08 min |
| Pratt & Whitney JT-6B | Centrif | 1 double entry | 9, tubular | Axial | 1 | 104 | 40 6 | 13 4 | 1,723 | 5,000 | 12,300 | 1 11 at 2,700 |
| Rolls Royce Derwent 5 | Centrif | 1 double entry | 9, tubular | Axial | 1 | 83 | 43 0 | 10 1 | 1,280 | 3,500 | 14,700 | 1 0 min |
| Allison 400-C4 | Centrif. | 1 double entry | 14, tubular | Axial | 1 | 102 | 50 0 | 13 6 | 1,805 | 3,825 | 11,500 | 1 31 at 2,180 |

provide high density air at high speeds; (2) a burner into which fuel is injected and burned with the compressed air; and (3) a turbine wheel which is rotated by the action of the expanding, hot, high-velocity gases on its blades. In turbojet engines the turbine supplies power to operate the compressor; thrust is obtained by means of the reaction pressure of the hot expanded, high-velocity gas as it escapes through the tail pipe of the engine. A turboprop engine is fitted with a frontal propeller driven by the turbine shaft through a gear reduction transmission in order to reduce its revolutions per minute; jet thrust from the escaping gases is also available. Gas-turbine engines are especially efficient for propelling high-speed, high-altitude planes. Low-grade fuels can be used, such as those having a kerosene base or low-quality gasoline.

All reaction engines develop thrust through the reaction force of hot gases expanding from a combustion chamber. In addition to gas turbines, other examples of reaction engines are pulsejet, ramjet and rocket engines. They have few or no moving parts and find application for driving aircraft at extremely high speeds by developing tremendous power; fuel consumption is enormous. Fuels are either liquids or solids; ordinary gasoline, alcohol and liquid oxygen and solid combustibles are typical propellents.

**Engine Requirements.**—The discussion which follows pertains primarily to air-cooled reciprocating engines.

The compelling objectives of engine research and development are to obtain a maximum of thrust for a minimum of frontal area, engine weight and fuel consumption. Steel as well as light, strong alloys of aluminum and magnesium are employed for construction of crankcase and pistons. Resistance to high temperature is needed. Special high-strength alloy steels are used for gears, crankshaft, valves, etc. Cylinder barrels and cylinder heads are air-cooled by using a large number of closely spaced fins around their outsides; cooling air, under pressure from high speed, is forced around such parts by cowling and baffles which fit closely around the outside of the engine. The cowling also forms a streamline body enclosing the engine and reducing air drag to a low value. Cowl flaps or gills, adjustable by the pilot, control the amount of air passing over the engine; these can be opened wide on the ground, where maximum cooling is needed, and adjusted in the air so as not to cool the engine excessively under low temperature conditions.

Two spark plugs are used for each cylinder to increase reliability and obtain greater combustion efficiency. Intricate carburettor and fuel injectors which have automatic altitude compensation devices for maintaining proper fuel-air mixture ratios are installed; otherwise, as the air density falls with altitude, the flow of fuel would be excessive. Again, with increasing altitude, the power output of the engine falls off because of the reduced density of air and the resultant reduced mass of air drawn into the cylinders for combustion; superchargers, in the form of blowers or compressors, are provided to compress the air fed to the cylinders to make up for this deficiency. As a result, a typical supercharged engine, which develops a normal power of 1,070 h.p. at sea level, provides 1,100 h.p. at its critical altitude of 7,000 ft.

By increasing the compression of the cylinders, a large increase in power output is possible, but too great a compression produces detonation-knocking in the engine. This condition is detrimental to the engine. Special fuels with good detonation characteristics, identified as high-octane fuels, are available to reduce the severity of knocking. Still further improvement can be attained, especially during high-power take-off conditions, by injection of water directly into combustion chambers. This cools the hot gases somewhat, thus suppressing detonation, and allows higher powers to be drawn for the short time needed at take-off.

**Performance and Operation.**—Important to the designer in determining speed, range and performance of aircraft are the engine performance charts. These are in the form of carefully prepared curves showing the engine power output under varying conditions of revolutions per minute, intake (or manifold) pressure and atmospheric pressure (altitude effects) based on standard air conditions. Data of this nature are carefully prepared from engine-dynamometer test data. Information on the fuel and oil consumption characteristics are also obtained.

Engines must be carefully controlled and operated in order to obtain maximum efficiency, range and dependability. In addition to the throttle, there are many other controls and instruments such as manifold pressure gauges, tachometers (revolutions per minute indicators), oil pressure gauges, temperature gauges and controls, fuel mixture controls and propeller pitch controls.

In addition to furnishing power for propulsion the engine also drives accessories such as fuel and hydraulic pressure pumps, electrical generators and air compressors.

**Propellers.**—The use of propellers to provide propelling thrust for marine craft and aeroplanes has long been familiar. In principle, thrust is obtained by imparting momentum to the column of air which passes through the propeller disk. The larger the disk area, the greater the pitch of the blades, and the higher the revolutions per minute the greater the amount of thrust force produced.

Important considerations to designers are the thrust, power and efficiency of a propeller. To determine such factors it is possible to apply simple laws of aerodynamics, since, in effect, the propeller is an airfoil moving in a curved path, thus developing lift and drag forces similar to those of a wing. In level flight, propeller thrust must equal the total air drag of the plane. The power delivered by the engine must equal that required to overcome the torque of the drag forces of the propeller. The efficiency of conversion of engine power to useful work is measured by the ratio of thrust horsepower to engine horsepower; values of propeller efficiencies of 85% are usual at cruising speed.

Propellers consist of blades and a hub, which may be of one-piece laminated wood construction, or of separate blade and hub construction; in such cases blades of wood, solid aluminum alloy or hollow steel materials are used.

Two general types of propellers are employed—fixed pitch and variable pitch; here, pitch refers to the angular setting of the blade with reference to its plane of rotation. A fixed pitch propeller can provide maximum efficiency at only one value of air speed to revolutions per minute ratio. A "best efficiency" propeller is one where the pitch can be continuously increased from low pitch at take-off speed, where large thrust is desired, to high pitch at high speed. Modern transports are equipped with such variable-pitch propellers; the hub encloses the complete pitch change mechanism, using either an electric motor or hydraulic actuator, and a constant speed governing mechanism which automatically maintains the engine revolutions per minute at the value selected by the pilot.

Two-, three- and four-bladed propellers are used. All propellers have an undesirable torque reaction which tends to cause the plane to roll; correction must be provided by adjustment of aerodynamic forces. Dual-opposite rotating propellers were developed to correct the condition but were not used extensively since torque reaction can usually be overcome adequately by less complex means.

Propellers are limited as to size and air speed. Physical limitations of ground and body clearances limit diameters. Propellers adequate to absorb more than 3,500 h.p. were developed. At extreme high speeds, approaching the speed of sound in air, propeller efficiencies deteriorate rapidly; hence, it seemed that their use would be confined to subsonic speed aircraft. For the same reason the rotational speed is limited to keep propeller tip speed within reasonable values.

Propeller icing can be prevented by alcohol deicing or by electrical heating elements.

"Feathering" of propellers to a 90° pitch position reduces air drag in the event of an engine failure, thus making flight with the remaining engines easier. Full reversal of pitch, as mentioned previously, allows application of rearward thrust while on the ground, thus providing an added safety feature to shorten ground roll on landing, the propeller serving as an air brake.

## NAVIGATION

For clear-weather flights (visual or contact flying), orientation

and navigation are relatively simple and can be accomplished by reference to the ground, use of magnetic compass and air maps. For blind flying, however, where ground, sun or stars are invisible, elaborate instrumentation is necessary. Instruments can be grouped into four main categories: power plant, flight, navigation and landing.

**Power-Plant Instruments.**—These tell the pilot that the engines are being properly operated. They include the tachometer, for showing engine speed, pressure gauges for intake manifold, fuel, vacuum and hydraulic pressure, temperature indicators for motor, oil, carburettor and outside air temperatures, electrical gauges and fuel quantity indicators.

For multiengined aircraft these gauges are duplicated, one set for each engine.

**Flight Instruments.**—The purpose of such instruments is to indicate that the plane is being correctly and safely flown. Airspeed indicators show the speed and warn against flying too slowly (to avoid stalls) and too fast for structural safety. Machmeters indicate nearness to speed of sound, which varies with altitude. Altimeters indicate height of flight to aid the pilot in preventing collisions. Rate of climb instruments indicate ascent, descent or level flying.

The attitude of the airplane (*i.e.*, roll or pitch condition) is indicated by means of gyroscopic instruments which show the amount of bank and pitch in degrees from the normal attitude. Turns about a vertical axis are indicated by other similar instruments.

Many variations of gyroscopic instruments are used; the simplest is the turn and bank indicator. Others are stabilized magnetic direction indicators, free type directional gyros, artificial horizons and attitude gyro indicators. All these instruments incorporate a high-speed rotating wheel mounted in gimbals, which substantially maintains a fixed "reference" plane of rotation irrespective of disturbance to the plane. The gyroscope principle is incorporated into automatic pilot sensing controls to achieve controlled flight.

**Navigation Aids.**—The pilot needs guidance in the air so that he can set his course to his destination. Common magnetic compasses are inadequate, except for ground contact flying, since they are easily disturbed in rough air, are subject to many errors and can indicate only direction of heading and not location. Radio means are therefore used extensively for navigation under instrument conditions. Radio waves projected along invisible "airways" guide planes along a radio "beam" to the airport. Morse code transmission of two letters, –A and N–, tell the pilot if he is off course to the right or left by the letter he hears. Because of traffic congestion and poor reception under heavy static conditions, this system was being replaced at mid-century by very-high-frequency, omnidirectional radio ranges called VOR. The pilot sets his course on an indicator and can fly cross country by reference to a vertical pointer.

**Landing Instruments.**—Under clear weather conditions, approaches to airports and landings can be made easily by the pilot without the aid of special instruments. Radio devices are needed, however, under bad visibility conditions, to help locate the airport, line up with the proper runway, descend and make ground contact safely.

Two systems are used: one in civil aviation called instrument landing system (ILS) and the other ground controlled approach (GCA), a radar device. ILS consists of three radio aids: (1) a radio beam, the localizer, which guides the pilot right or left as he lines up to approach the runway; (2) a glide path, which guides him down at a safe angle from a point about 3,500 ft. from the end of the runway; and (3) an aid which consists of three marker beacons along his path, telling him his distance from the end of the runway (3 mi., 3,500 ft. and the end of the runway). In the GCA system, the plane is pictured as a "blip" on a radar screen in the control tower, and the radar operator informs the pilot of his position with respect to his right and left path and his position above or below the glide path.

The final landing is made visually after "breaking out" of the bottom of the cloud layer, usually not less than 200 ft. The final aid to the pilot consists of high-intensity approach lights which lead him to the approach end of the runway and give visual guidance.

Automatic control devices are under development to accomplish the above approach to landing automatically; otherwise, in the ILS the pilot must do this manually by observing instruments. (*See* AERIAL NAVIGATION.) (B. L. S.)

**AEROPLANE.** The main problem that confronts the designer of any means of transport is to find a working compromise between the various demands of those who maintain and use the service. There is no conflict between the interests of the operator and those of the user. Their common requirements are safety, speed, comfort and adherence to a published timetable. As regards both safety and reliability, improvements in radio, the establishment of radio beacons, the installation of deicing apparatus, tremendous forward strides in instruments and aeroplanes, and improvements in operating facilities had great effects.

The cost of air transport by mid-20th century was comparable to first-class rail and ship accommodations Time saving and ease of travel were evident from the ever-increasing passenger traffic

For reasons which are explained in the article AERODYNAMICS a normal aeroplane cannot be maintained in flight at a speed *less* than a certain minimum "stalling" speed, which for a modern commercial aeroplane varies between 40 and 110 m.p.h. On the other hand, it is possible to give it enough engine power to drive it at between 90 and 400 m.p.h., while leaving a margin of some 20% of its total weight for passengers or goods. The aeroplane's permanent way, the air, is the only medium of transport which connects without interruption all places on the globe. It may be anticipated that the consequent possibility of transit free from the necessity of making transfers may prove to be as valuable as the speed which can be maintained.

From the point of view of design, with which this article deals, *safety* is discussed below; *comfort* is comparable to that of other types of travel and in the opinion of many, air travel furnishes superior comfort; and *reliability* (in so far as it depends on design) presents no special problems.

In what follows we shall discuss (1) the *Minimum Speed of Flight* and its influence on the design of aeroplanes; (2) the *Power Required for Flight,* including both that necessary to drive the aircraft through the air and also—the unique feature of transport by aircraft heavier-than-air—that expended in sustaining it in flight; (3) the possibilities of *Improvement of Performance* by reduction of resistance; (4) the *Origin of Aerodynamic Data of Design;* (5) the *Distribution of Weight* among the component parts; (6)

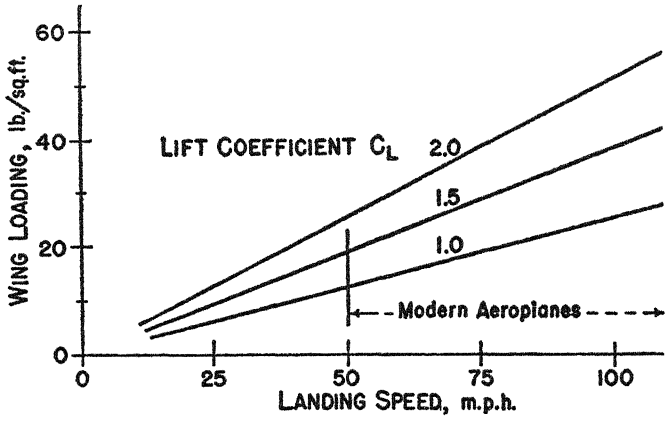



FIG. 1.—DIAGRAM SHOWING HOW THE LANDING SPEED VARIES WITH WING LOADING, W/S, AND LIFT COEFFICIENT, $C_L$

the *External Form of Aeroplanes,* commenting on the most conspicuous features of modern aircraft; (7) *Stability and Control* and their influence on (8) the *Safety of Air Travel;* concluding with notes on (9) *Structural Design* and (10) *Materials used in Construction.*

### 1. MINIMUM SPEED OF FLIGHT

It is the impossibility of steady flight *below* the stalling speed

that constitutes the chief danger of air travel. Many attempts have been made to avoid this source of danger by devising an aeroplane which would be capable, as a whole, of remaining stationary in the air. Such machines have generally employed either flapping or rotating wings, the so-called ornithopters (*q.v.*) and helicopters (*q.v.*). The former have shared the legendary fate of Icarus. The latter, however, were proved possible of construction and flight. By mid-century they were performing many useful services in commercial and military aviation. (*See* GYROPLANE.)

There is no fundamental obstacle to reducing the minimum speed of a normal aeroplane to about 25 m.p.h., instead of the 40 to 110 m.p.h. quoted above as typical of modern practice. In fact, the earliest flying machine had minimum speeds of this order. But the general proportions of such a machine would be uneconomical from every other point of view. In particular, almost the whole of the available weight would be absorbed by the structure and power plant, leaving no margin for paying load.

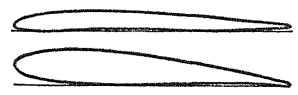


FIG. 2.—CROSS SECTIONS OF RECENT TYPES OF AEROPLANE WINGS

The relation between the total weight ($W$ lb.), the area of the wing ($S$ sq.ft.) and the aerodynamic coefficient ($C_L$) which determines their lift at any given speed ($V$ ft./sec.) (*see* AERODYNAMICS) is

$$W = C_L S \frac{\rho V^2}{2},$$

$\rho$ being the density of the air.

This may be put, for standard sea level air density, in the form

$$V = 19.8\sqrt{\frac{w}{C_L}} \text{ m.p.h.},$$

where $w = W/S$ and is called the wing loading, in lb./sq.ft. Fig. 1 shows the relationship of $w$, $C_L$ and landing speed. Fig. 2 shows the cross section of a vertical plane parallel to the direction of flight of some modern wing sections. For these the maximum value of $C_L$ (which in virtue of the above relation corresponds to the minimum flying speed) is between 1.1 and 1.5 for a plain wing. Modern commercial aircraft using such wings have loadings from 9 to considerably more than 50 lb./sq.ft. In the latter case from fig. 1, using $C_L = 1.5$, a landing speed considerably greater than 100 m.p.h. would be evident (to be exact, 114 m.p.h.). This is too great for safety except on quite large airports; reduction can be made in two ways: (1) by reducing wing loading or (2) by seeking aerodynamic means for increasing $C_L$. The former course leads to a reduction in the pay load. Much attention was therefore devoted to the latter method.

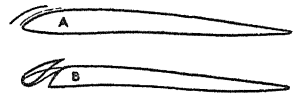



FIG. 3.—CROSS SECTION OF THE HANDLEY PAGE SLOTTED WING. WITH IT THE MAXIMUM LIFT COEFFICIENT CAN BE INCREASED ABOUT 50% OR MORE



FIG. 4.—METHOD OF VARYING THE CURVATURE OF THE WING. IN GENERAL, THE GREATER THE CURVATURE THE HIGHER IS THE MAXIMUM LIFT

A most effective high lift wing section is the "slotted" wing of Handley Page Ltd. (fig. 3). With this the maximum lift coefficient can be increased about 50% or more. The action of the device is, broadly speaking, to cause the flow characteristic of stalling (*see* AERODYNAMICS) to occur at a larger angle of incidence.[1] The increase in lift is dependent on the relative position of the main and auxiliary wings; *i.e.*, on the size and shape of the slot between them, which can be varied in flight. With the slot closed the characteristics are nearly the same as those of a normal wing. In this respect form (a) (fig. 3) is superior to form (b), but in practice there are, with both, constructional difficulties in the way of ensuring a smooth and unbroken surface when the slot is closed.

Another method which has been widely used is to vary the curvature, or "camber," of the wing (fig. 4). In general, the greater the curvature of a wing section the higher is the maximum lift, but the lower the efficiency at high speeds. This device attempts to secure both high lift and high efficiency by enabling the pilot to alter the curvature to suit the conditions of flight. The increase of lift attainable in this way is comparable to that achieved by the slot. By combining both these methods very high maximum lifts have been obtained. However, because of icing difficulties and mechanical complications this combination does not find much use; instead, other means of increasing lift were adopted.

A variation of the system of changing the camber is the use of flaps. Their use is now standard on the majority of air liners, having been necessitated by the greatly increased speeds. The increase in high speed and in cruising speed has inevitably increased the stalling speed and thus the landing speed. The employment of flaps has kept the landing speed at a practical figure. The use of flaps on the take-off also increases the lift and makes shorter take-off possible at the expense of speed. They are constructed by hinging the undersurface of the trailing edge of the wing in such a manner that the trailing edge may be opened by forcing down the undersurface by a system of control from the pilot's seat for landings and take-offs. Flaps were developed of several types, including a variation where the flap is extended rearward, using a system of linkage, and then deflected. Lift increase at stalling speed of as high as 100% was achieved, including the effects of propeller slip-stream velocity.

### 2. POWER REQUIRED FOR FLIGHT

Aerodynamic equations for drag and power required are usually expressed

$$D = C_{D_T} S \frac{\rho V^2}{2}$$

$$P = DV/550 \text{ h.p.},$$

where $C_{D_T}$ is the drag coefficient for the complete aeroplane, $S$ the wing area in square feet and $V$ is the air speed in ft./sec.

When an aeroplane of conventional design is flying horizontally (in air of a given density) the power of the engine is disposed of in the following ways: (1) About 15% is lost because of inefficiency of the propeller. (2) From 30% to 50% is used to overcome the air resistance of the body, including the engines, undercarriage, tail surfaces and other exposed body parts. (3) From 55% to 35% is similarly absorbed by the resistance of the wings. The large differences between the alternate values of (2) and (3) are caused by variations of speed, relative size of body compared with the wing, number of engines and type of aeroplane. As indicated by the formulas, the resistance of parts varies practically as the square of the air speed and the corresponding power as the cube thereof.

The aeronautical engineer, taking into account the above relationships between engine power and how it is absorbed by the aeroplane components, can prepare power characteristics charts for the plane. Fig. 5 shows this power relationship in simplest form. As speed increases the power required also increases rapidly from its lowest value at low speed. Note also that the power available from the engine increases likewise. Where these two curves intersect and the powers are equal, then the *high speed* in level flight is attained.

Fig. 5 also shows the relative effect of altitude on the power curves. It will be noted that there is a general increasing of power required and a lessening of power available. When that altitude is reached where the power available curve is just tangent to the power required curve, then the *absolute ceiling* has been reached.

Returning to the total resistance of the wings (3), this is divided by aerodynamicists into two parts, the *profile drag* and the *induced drag*. At high air speeds the profile drag can account for as much as 75% of the total. It is derived from the friction of air on the surface of the wing transmitted through a very thin layer of air (called the *boundary layer*) and from turbulence or *eddies* occurring aft of the wing trailing edge downstream.

The profile drag coefficient ($C_{D_P}$) increases only slightly as the wing angle of attack increases. Also, the thicker the wing airfoil section the higher $C_{D_P}$ becomes.

The induced drag accounts for from 25% to upward of 60% of

[1] Angle of the chord to the longitudinal axis of the aeroplane. The chord of the wing sections in fig. 2 is indicated by a straight line.

the wing drag (*see* AERODYNAMICS; the *induced* drag of L. Prandtl). This arises from the rearward component of lift generated by the wing; for a given lift force it varies inversely as the square of speed and wing span. Large span wings are, therefore, most suited for slow-speed aircraft, or gliders, where low induced drag is sought.

The merit of separation of the aeroplane's total drag into various elements is evident since it allows the designer to examine the economics of each and to determine which will provide most fruitful benefits, if improved.

By referring again to fig. 5 other important considerations can be revealed. For example, flying at the maximum speed. using full engine power, is uneconomical from the point of view either of the life of the engine or fuel consumption. Reducing engine throttle to power outputs of about 60% to 75% maximum is more economical; the resulting speed is called the cruising speed.

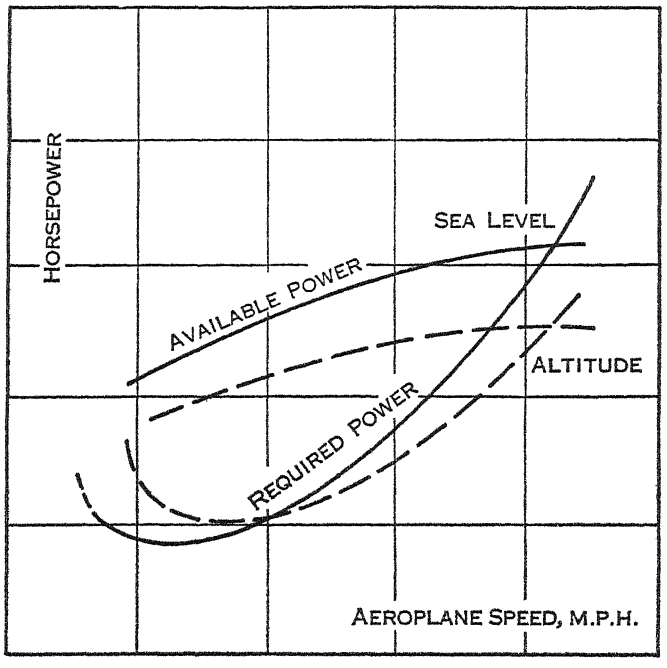



FIG. 5.—TYPICAL VARIATION OF POWER CURVES FOR AN AEROPLANE SHOWING THE RELATIONSHIP OF POWER AVAILABLE FROM THE ENGINE TO THAT REQUIRED FOR FLIGHT, AT SEA LEVEL AND AT ALTITUDE

The difference between the maximum power available and power required curves, at a given air speed, is called the excess horsepower. This is the amount of power available for rate and climb, expressed in ft./min. The speed for *best climb* is that point where the excess power is largest; *i.e.*, somewhat higher than that where power required is a minimum. Rates of climb can vary from 300 ft./min. for small planes to more than 8,000 ft./min. for jet-powered aircraft.

### 3. IMPROVEMENT OF PERFORMANCE

**Propeller (Airscrew) Efficiency.**—A loss of between one-quarter and one-third of the power of the engine in the transmission assembly would hardly be tolerated in road or rail transport. Transport by water, however, is burdened by a loss identical in character and similar in amount. It arises from the fact that the propulsive force is obtained by driving a fluid backward. This condition cannot be entirely overcome, but propeller efficiency can be and is being greatly increased. Commercial aeroplanes have an altitude operating range from sea level to 25,000 ft. At 15,000 ft. the air density is approximately half that at sea level. Further, the plane's speed varies from zero at take-off to any value up to its maximum speed. A constant pitch propeller obviously will not operate at highest efficiency throughout these variable conditions. If it is designed for high efficiency at the surface, where maximum power is desired for take-off, it will have low efficiency at normal cruising altitudes and speeds. Resort is therefore made to adjustable pitch, controllable pitch and automatic propellers. The first is adjustable on the surface with motors dead. The second is controllable by the pilot while in flight. The last is automatic. All these types became standard equipment. (*See* AIRSCREW.)

**Jet Propulsion.**—For very high altitudes, 40,000 ft. or more, and extreme high speeds the propulsive efficiency of the propeller and the power output of the reciprocating engine drops to such low values as to become uneconomical. Here the jet engine becomes superior from both standpoints. In the rarified upper atmosphere the compressor turbine of the jet engine boosts the pressure of the inlet air, thus increasing the quantity of intake oxygen to burn with the fuel. Thrust is obtained as a result of the reactive pressure of the expanding hot, high-velocity gases released through the tail pipe of the engine. Because of its small frontal area and low cooling loss compared to reciprocating engines (energy lost as a result of cooling cylinders) much lower air drag is realized which adds further to its advantage. At low air speeds, such as at take-off, the jet turbine is quite inefficient; as a result, high speed and altitude must be reached quickly to conserve fuel. In a typical 3,000-lb. thrust jet engine as much as 400 gal. fuel per hour may be burned at cruising speed.

**Resistance of the Body.**—In modern aeroplanes body drag must be kept to a low value. All possible equipment and parts are stored within fuselage and wings. The junction of fuselage and wing is carefully filleted, windshields are placed at proper angles, the shape of the body is carefully planned and its exact positioning on the wing designed to give lowest air drag when the wings are at normal cruising angles.

The reduction in resistance of engines is a problem usually solved by encasing them in aerodynamically efficient "nacelles." Further improvement in the form of actual forward thrust can be realized by recovering some heat energy, otherwise lost, in the cooling air and exhaust gases. Proper ducting of the heated gases accomplishes this.

Liquid-cooled engines had been practically abandoned by mid-century because of large drag losses of cooling radiators.

**Resistance of the Undercarriage.**—The undercarriage of an aeroplane has a high resistance, mainly because of the wheels. This condition was met in two ways. The wheels and landing gear may be covered with cowling in a streamline shape or the landing gear may be retractable. In the latter case the landing gear is hinged in such a manner as to permit it to fold into the wings, fuselage or engine nacelles. The retraction in usually activated by hydraulic or electric systems. Both methods of resistance reduction are in current use. The cowling (commonly called "breeches") is more common for small aeroplanes and the retractable gear for large ones.

**Resistance of the Bracing of the Wings.**—The early aeroplane was a mass of external struts and bracing with cables between wings, from wings to fuselage and engine bed, and between the various fixed and movable controls. The tendency thereafter was toward "clean" design. Modern construction methods and materials permit all bracing for monoplanes to be internal. Whereas this requires increase in weight, it is largely balanced by increase in aerodynamic efficiency. All modern high-speed transports and military aeroplanes are aerodynamically "clean" and highly streamlined. As speed requirements increase even rivet heads are made flush with the surface.

**Supercharged Engines.**—To avoid excessive power loss with increase in operating altitude, engines incorporate superchargers (centrifugal compressors) which increase the intake manifold pressure considerably over atmospheric pressure. An unsupercharged engine, if taken from sea level to 10,000 ft., suffers a loss of about 30% of its power. On the other hand, it is possible for a supercharged engine to deliver more power at altitude than it can at sea level.

### 4. ORIGIN OF AERODYNAMIC DATA OF DESIGN

The designer bases his calculations on data derived from four main sources: (1) Theoretical investigations, such as the Lanchester-Prandtl theory of the action of wings. (2) Experiments on models in wind tunnels. (3) Experiments on full-scale aero-

planes in flight. (4) Analysis of the measured performance of aeroplanes. References to the first of these divisions will be found in the article on AERODYNAMICS, where also the principles underlying experiments on models are dealt with.

**Wind Tunnel.**—The wind tunnel has played a great part in the development of aeronautics. Many manufacturing firms possess their own tunnels, used mainly for measurements of the resistance of aeroplane bodies, etc., with a view to improving performance. National wind tunnels exist in many countries, generally reserved in principle for research on problems of wide interest and application.

The main advantage of model experiments is the ease with which the experimenter can control the conditions.

**Full-Scale Experiments.**—Most of the leading aircraft-producing countries carry out full-scale experiments. In Great Britain they are made at the Royal Aircraft establishment under the control of the director of scientific research at the air ministry. In the United States they are carried out by the National Advisory Committee on Aeronautics, by the air forces and by most manufacturers.

**Analysis of Performance Tests.**—The measurements of speed and climb which are made during the acceptance tests of aeroplanes are a valuable source of information for the designer. Their analysis enables an over-all comparison between various types to be made on a rational basis, but necessarily lacks something in precision. For each type differs from the others in many features, so that, for example, an observed difference in speed cannot safely be ascribed to any one peculiarity. But with suitable precautions reliable information can be obtained in a convenient form. It is found that the factors which have the greatest influence on the speed and climb of an aeroplane are the *horsepower per unit of total weight* and the *total weight carried per unit of wing surface*. For further details of the method, and its limitations, reports of the National Advisory Committee for Aeronautics (U.S.) or of the Aeronautical Research committee (British) should be consulted.

## 5. DISTRIBUTION OF WEIGHT

Fig. 6 illustrates the relative proportions of the total weight taken up by the various sections into which it is convenient to divide the component parts. The figures apply to an average commercial aeroplane of moderate size. The distribution of weight varies from one machine to another.

**Structure.**—The "structure" includes a great deal which is not part of the essential structure of the aeroplane. A change in the specified strength affects about 60% to 70% only of the nominal structure weight.

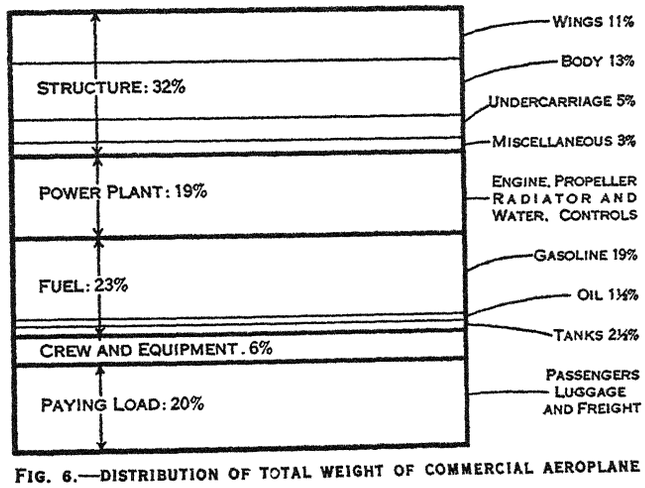



FIG. 6.—DISTRIBUTION OF TOTAL WEIGHT OF COMMERCIAL AEROPLANE

**Power Plant.**—The weight of the power plant depends mainly on the desired maximum speed of the aeroplane, and on the weight of the engine and its equipment per brake horsepower. There is generally a reduction in this item if an air-cooled engine is used instead of a water-cooled engine.

**Fuel, etc.**—The weight of fuel and tanks is dependent on the speed and duration of flight specified, and on the standard of fuel economy reached by the engine. The latter factor varies little for modern engines, both air- and water-cooled engines now giving one brake horsepower hour for about one-half pound of gasoline.

**Crew, etc.**—The crew and equipment tend naturally to absorb a progressively smaller proportion of the total weight as the size of the aeroplane increases.

**Pay Load.**—The pay load, being the balance after the above items have been accounted for, is from 13% to 20% of the gross loaded weight of the aeroplane. For slower aeroplanes it may reach a much higher percentage. Compared with other means of transport this is a high proportion. Both a passenger railway train and an ocean liner carry a much smaller percentage of pay load. That these means of transport are able to offer lower fares than aircraft is partly because of the higher running costs of an aeroplane per passenger mile, but mainly because of the fact that the volume of passenger traffic is as yet small compared to that of other common carriers.

The essential need for economy of weight in aircraft is due not only to the fact that but one-fifth of its weight is available for pay load, but to the higher cost of carrying this load by air, as compared with other ways. A saving in the weight of some part of the aeroplane of 1% of the whole allows a reduction of the cost of transport by about 5%.

## 6. EXTERNAL FORM OF AEROPLANES

**Wings.**—There is a striking variation in the appearance of wings of most modern planes as seen in plan. One thing they do have in common is large aspect ratios of about 6 or more (ratios of span to average chord). This is intended to keep *induced* drag caused by lift as low as possible. Three of the simplest plan shapes are shown in fig. 7. Variations of taper in chord (fig. 7b) and sweepback (fig. 7c) as well as actual wing tip shape distinguish planes from each other. These modifications are intended to enhance certain aerodynamic characteristics as desired by the designer such as good stall characteristics, manoeuvrability, large centre of gravity range, stability characteristics, etc. Extreme sweepback up to 45° is provided for jet-powered planes to reduce compressibility shock effects and trim changes which occur as the plane reaches the speed of sound (760 m.p.h. at sea level, standard air).

Near the tip of each wing is an *aileron* or a lateral control surface hinged about axes 1–1 (fig. 7a) and interconnected so that an upward movement of one is accompanied by a downward movement of the other. They are operated by rotation of the pilot's control wheel on the control column, and are the means for maintaining straight flight, or banking for a turn. (*See* also AILERON.)

High-lift wing flaps are also located along the trailing edge of the wing between the inboard end of the aileron and the fuselage. These are also hinged and are extended by the pilot, particularly on approach to landing, to decrease the landing speed. Partial extension is sometimes used to enhance take-off.

*Wing Incidence.*—The angular setting of the wing with respect to the longitudinal axis of the plane is called the angle of incidence in Great Britain and angle of attack in the United States; it is the angle between the airfoil chord line and the direction of the wind.

*Number of Wings.*—The appearance of aeroplanes in front and side elevation is as varied as in plan, mainly because of the use of one or more wings, engines, varied shapes of fuselage, etc.

It is of historical interest to note that biplanes, triplanes and even quadruplanes were in vogue from early years through 1922. Slowly these were displaced until even the biplane became a rarity. The trend to the monoplane was caused by the development of wing sections of great thickness, the desire to eliminate external bracing for drag reduction reasons and the development of high strength aluminum alloys permitting the use of stressed skin wings and fuselages.

In a biplane the relative position of the wings with respect to one another is defined by *gap*—the distance between the chords of the upper and lower wings—and *stagger*—the amount one wing is

set ahead of the other as measured by the horizontal distance from the leading edge of the upper wing to the corresponding point on the lower wing. These factors have considerable significance to

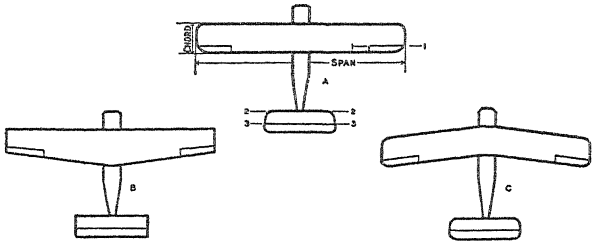



FIG. 7.—THE RELATIVE SIZES AND AREAS OF AEROPLANES, SHOWING THE SPAN OF THE MAIN WINGS IN RELATION TO THEIR CHORD, FROM WHICH THE AVERAGE RATIO OF SPAN TO CHORD MAY BE DEDUCED

the aerodynamicist who wishes to evaluate the mutual interference effects of the air flow over the respective wings by calculation.

Monoplanes vary in respect to position and shape of wings, type of fuselage and arrangement of tail areas, type of landing gear and number of power plants. Typical variations in front and side views are shown by figs. 8 and 9; in these figures, (a) shows an externally braced, high-wing, tail wheel type, light monoplane, (b) a low-wing, internally braced, tricycle gear monoplane, (c) a low-wing, twin-engine tricycle gear transport and (d) a four-engine, tricycle gear, low-wing air-line transport.

**Horizontal Tail Area.**—At a distance of approximately three chords behind the leading edge of the wings is the tail plane, in area about one ninth that of the wings. In steady flight its function is to balance or trim the aeroplane; *i.e.*, to ensure that the resultant of all the air forces on the aeroplane passes through the centre of gravity. (*See* AERODYNAMICS.) It is generally in two parts. The front part, about 60% of the whole, is normally fixed, though means may be provided by which the pilot can alter its angle of incidence by rotating it about an axis such as 2–2 (fig. 7a), thus enabling the aeroplane to be trimmed for flying at various speeds This operation is analogous to trimming the sails of a ship so that it carries no weather or lee helm.

In a modern aeroplane a movable tail plane is generally considered indispensable, unless trimming planes such as trim tabs (described later) are used, in which case the stabilizer need not be adjustable.

The rear part of the tail, or *elevator,* is hinged on an axis such as 3–3 (fig. 7a), and connected to the control column in such a way that a forward movement of the pilot's hand depresses the trailing edge of the elevator and causes the machine to dive, and vice versa. The elevator is the primary control organ of an aeroplane, since by it the pilot alters the angle of attack of the wings and hence in conjunction with the engine power controls the rate of climb or descent and the speed.

**Vertical Tail.**—The vertical stabilizing and controlling surfaces, a fixed fin and a movable rudder connected to foot pedals on which the pilot's feet rest, are generally situated at the aft end of the fuselage above the horizontal surfaces. They perform the same function as the rudder in a boat. The fixed fin provides directional stability; *i.e.*, it tends to keep the plane on a straight course. The hinged rear part of the vertical tail, or rudder, serves two functions; it provides a means to allow the pilot to "yaw" the aeroplane and change direction of flight, and it is used to trim the plane for straight flight, particularly when one wing engine of a multiengined aeroplane may not be operating. This latter function is quite important since the remaining engines have a tendency to lift the wing on one side more than the other and pull the plane into a power spin.

Rudder control forces for a large multiengined plane can be quite high and require considerable exertion on the part of the pilot. Accordingly, *trim tabs* are provided on the rudder to assist the pilot. These are small hinged surfaces attached to the trailing edge of the rudder, which, when moved (for example, to the right), force the rudder to the left because of its aerodynamic forces, and effectively simulate application of "left" rudder pedal by the pilot. When adjusted properly the tab holds just enough rudder to maintain straight flying despite adverse yawing forces of an inoperative engine.

Variations of the trim tab principle, known as balancing tabs, servo-tabs or flying tabs, etc., are also employed, particularly on very large planes, to allow the pilot to manoeuvre without excessive rudder pedal pressures. These devices automatically assist the pilot to move the rudder in the desired direction as he presses the rudder pedal.

For small single-engine planes it is sometimes possible to dispense with a rudder entirely; thus we have the "two-control" plane (aileron and elevator control only). In such planes it is also necessary to limit the upward travel of the elevator to preclude development of wing stalling with subsequent entry into a spin; without a rudder recovery from a spin might become difficult if not impossible.

**Location of Power Plant.**—Engines, propellers, oil tank, accessories and controls are enclosed in body forms called *nacelles.* With few exceptions, "tractor" positions of propellers are used, although "pusher" arangements are seen now and then When two or more power plants are used it is customary to distribute them along the wings; each engine nacelle is in itself an integral unit able to function independently of others. Two and four engines are common, although trimotors are seen where the one engine is located in the nose of the fuselage. The vertical location of the "thrust axis" with respect to the plane's centre of gravity is important since care must be taken to avoid giving rise to large couples which would otherwise tend to rotate the aeroplane in a vertical plane as throttles are altered. Care must also be taken to locate tail surfaces above the propeller slip stream to avoid troublesome vibrations.

**Fuselage and Landing Gear.**—The fuselage serves as a connecting member of wings, power plants, tail surfaces and landing

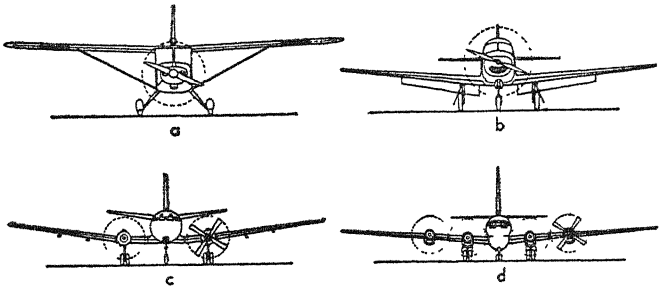



FIG. 8.—FRONT VIEW OF TYPICAL MONOPLANE ARRANGEMENTS: (A) THE PIPER STINSON VOYAGER; (B) THE RYAN NAVION; (C) THE MARTIN 2-0-2 AIRLINER; (D) THE BOEING STRATOCRUISER

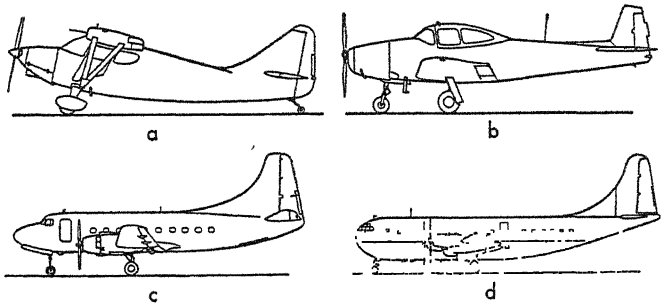



FIG. 9.—SIDE VIEW OF MONOPLANES SHOWING NOSE-WHEEL AND TAIL-WHEEL TYPE LANDING GEARS: (A) THE PIPER STINSON VOYAGER; (B) THE RYAN NAVION; (C) THE MARTIN 2-0-2 AIRLINER; (D) THE BOEING STRATOCRUISER

gear. It also contains accommodations for operating crew, passengers and cargo. Sometimes fuel tanks are included but mostly these are placed within the wing structure for safety and to conserve space. Open cockpit fuselages, where occupants are exposed to the air, were displaced by closed cabins, with opening doors on

the side or sliding canopies in the top to permit entry. On large transports, emergency exit openings are provided to permit rapid egress in the event of accident. The fuselage is designed as a boat hull, in flying boats, to permit operation from the water surface.

Landing gears are usually seen in tail-wheel or nose-wheel (tricycle) configurations. (*See* fig. 9.) For large transports, dual wheels are sometimes used on each landing gear strut to reduce wheel loads.

Retracting mechanisms are employed to rotate the gear upward into recesses in the wing and fuselage structure.

### 7. STABILITY AND CONTROL

The general principles of stability and control are dealt with in the article AERODYNAMICS, and the stabilizing and controlling surfaces have been referred to above. The necessary disposition and dimensions of these surfaces are decided in practice chiefly by direct comparison with previous designs. Since, however, aeroplanes are not merely scale copies of one type, some rational means of using the accumulated experience of previous work is essential, and it is this that research into the fundamentals of stability and control is able to supply. Needless to say, even these methods break down when the aeroplane in question is not broadly similar to those from which the data are derived, and then nothing short of a thorough investigation, assisted by model experiments, will suffice. Very often, even with the best that can be done in this way, uncertainties remain, and the designer is forced, as in other branches of engineering design, to rely upon his ability to draw conclusions from insufficient premises.

**Stability.**—Stability, the property of returning to a steady state of motion when deliberately or accidentally disturbed, implies as a necessary preliminary the existence of equilibrium, or "trim," in that state. An aeroplane is trimmed for a steady condition of flight by an adjustment of its tail plane, or adjustment of the trim tab controls, the elevator being left free. The degree of stability generally considered desirable for a commercial aeroplane can be attained by arranging the size of tail plane and the fore and aft position of the centre of gravity within certain limits. The further back the centre of gravity, the larger is the necessary tail area. The fore and aft position of the centre of gravity in relation to the wing is defined by its distance from a plane passing through the leading edge of the wing perpendicular to the chord, for a monoplane; for a biplane an equivalent monoplane wing is substituted. In normal aeroplanes this distance is usually about one-third the chord, though it has varied between one-quarter and one-half. The height of the centre of gravity of an aeroplane in relation to the wings has a secondary effect on its stability. In particular, a low centre of gravity is not necessary for stability.

Adequate stability is usually present when the horizontal tail area is approximately 12%–15% of the wing area and when a tail length ratio of from 2.5 to 3.0 is provided, the latter ratio being the distance from the tail plane to the centre of gravity divided by the wing chord.

Elevator areas of about 40% of the horizontal tail surface area usually provide sufficient controllability for the range of position of centre of gravity normally employed.

Lateral and directional stability depends mainly on the provision of adequate fin and dihedral angle. Good stability in these directions is of importance to comfort and instrument flight.

**Aileron Control.**—Ailerons of an area between one-twelfth and one-eighth of that of the wings are usually provided, and give adequate control at all normal flying speeds. At low speeds, however (more accurately, at angles of attack of the wings in the neighbourhood of stalling), not only are normal ailerons ineffective, but they may actually become a source of danger, their use aggravating an inherent tendency of the stalled wings to force the aeroplane into a spiral dive or spin. (*See* AILERON.)

**Rudder Control.**—An effective rudder is as essential for safety at low speeds as effective ailerons. The efficiency of any given rudder depends on its being arranged so that the body does not shield it, but it is found that when the product of the ratios

$$\frac{\text{area of rudder and fin}}{\text{area of wings}}$$

and

$$\frac{\text{distance of rudder from centre of gravity}}{\text{semispan of wings}}$$

is above one-twentieth, a satisfactory control is obtained. The latter ratio is usually about one, so that the former should not be less than one-twentieth. The area of the rudder is generally about two-thirds that of the rudder and fin combined.

**Automatic Pilot.**—All modern transport aeroplanes are equipped with an automatic gyroscopic pilot. The device is designed to pilot the plane on a given heading. It can be adjusted for climb, descent or for turns It is so arranged that the pilot can over control by the normal use of control column and rudder.

The automatic pilot has many advantages. It produces more steady flight than is otherwise possible and permits the pilot to attend his radio and navigational duties with greater freedom. Although it is not a normal practice, it may be set for take-off or landing.

### 8. SAFETY OF AIR TRAVEL

Air travel would have been much more quickly adopted except for a general public apprehension of the risks involved. These risks are associated with the following causes: (1) physical failure or error of the pilot, (2) fire when in flight, (3) collision when in flight, (4) breakage of the structure and (5) forced landing. Dangers of the first four types are not peculiar to aircraft and the precautions they involve are common to transport by road, rail and sea. The measures adopted in air transport largely eliminated them. It is mainly the dangers which may arise when an aeroplane is forced to land that loom large in the minds of those who might otherwise travel by air. While it cannot be said that these fears are entirely unwarranted, yet in so far as the design of aircraft is involved the position rapidly improved.

**Forced Landings.**—Forced landings may be necessitated by engine trouble, structural failure, fuel shortage, weather, ice forming on the aeroplane or loss of knowledge by the pilot of location. A well-qualified pilot with a properly equipped aeroplane should not experience forced landings caused by loss of bearings, and should never experience fuel shortage. Forced landings caused by weather, while annoying, are not dangerous in a country well-equipped with emergency landing fields. Structural failures are extremely rare in normal flight. Ice forming on the wings and propellers, however, was formerly a serious problem. The danger of ice is twofold. It adds considerable weight to the structure and at the same time decreases the normal efficiency thereof by spoiling the lifting qualities of the wings and the traction qualities of the propellers. Some trouble has also been experienced by ice forming in carburettors and reducing engine power output. However, invention as well as the development of efficient meteorological services and weather broadcasting systems largely if not completely met the situation. It would be a rare phenomenon if ice-forming conditions existed throughout the altitude range of the aeroplane. Altitudes for flight should be sought which do not favour icing. To arrive at such altitudes, however, it may be necessary to pass through icing layers. Since clear ice, under severe conditions, can form at the rate of three inches per minute, it is an important problem which gave much cause for thought and experimentation. Its importance was more keenly felt after the development of instrument flying. Formerly little cloud flying was attempted but with modern methods cloud flying is nearer the rule than the exception.

To prevent ice from forming in carburettors, heaters are installed to warm the incoming air. Propeller deicing is accomplished in one of two ways, either by use of a liquid solution using alcohol as a base or by electrical heating. The liquid solution is applied by centrifugal force through a rotating slinger ring onto the surface of the blade at the blade hub. Electrical heating is accomplished by specially developed coatings on the blade surface which become

heated as an electrical current is passed through it.

Two systems of preventing ice from forming on wings are used. One involves the use of pneumatic driven, pulsating, rubber pads on the leading edge; the pulsations crack the ice to be carried off by the air. Thermal heating of wing leading edges is another means; the waste exhaust heat from the engines is usually ducted along the leading edge for this purpose.

From the height of about 3,000 ft., for a single-engine plane, approximately four minutes are available in which the pilot may choose a landing place. If the failure occurs before the aeroplane has reached its cruising altitude, the time and the corresponding area of ground in which this landing place is to be found are reduced in proportion. These considerations unfortunately may result in the pilot's having to execute somewhat sharp turns in order to place the aeroplane correctly, and it is during these that the controllability of the machine is most severely tested. The ultimate danger lies in the fact that the speed of horizontal travel at the moment of landing cannot possibly be less than the stalling speed. In practice with a typical small plane in level flight it will be between 55 m.p.h. and 70 m.p.h. In a banked turn it can be from 15 m.p.h. to 25 m p.h. higher because of the higher lifts required under the acceleration forces of the turn. The inexperienced pilot, in an endeavour to make the most of what space is available, frequenty turns too tightly, stalls at a speed higher than he normally would expect and, before recovery can be completed, loses excessive altitude or spins and crashes.

### 9. STRUCTURAL DESIGN

**The General Problem.**—The discussion so far has concerned aerodynamic and performance aspects of the aeroplane. Of equal importance to the success of the plane is the internal design or structure which, while being extremely light, must still have the strength needed to cope with all possible loads it can experience in service. It must also be reliable in service and incorporate all known safeguards for safety. The modern plane structure (or air frame) is an intricately complicated unit requiring great ingenuity on the part of designers and necessitating many compromises before reaching its final form. A plane which is properly designed and meets all government regulations for strength and reliability is termed structurally airworthy. The art of designing for all safety requirements and proving that an airplane meets these requirements is denoted by the general term "airworthiness."

The structural airworthiness of the plane involves not only the use of ordinary principles applicable to conventional engineering structures but many specially developed theories applicable to thin shell structures which "fail" by elastic buckling. Great care must be taken to select proper materials and use these materials most efficiently by proper shaping, forming and joining. To proportion structural elements suitably a knowledge is required of the external, or applied, loads to calculate the stresses in each element. The margin between the stresses, so calculated, and the minimum safe or allowable stress for the element is the safety margin. As a minimum requirement this margin, on most commercial planes, must equal 50% of the applied load (*i.e.*, a factor of safety of 1.5 above the applied load must be attained before ultimate failure load is reached).

Assurance of reliability of structural parts is also essential to airworthiness. This simply means that they must be rigid enough to withstand abuse in service, must not be subject to disastrous fatigue failures caused by repeated loadings or vibrations, and must have ability to withstand wear or deterioration in adverse atmospheric conditions. An unreliable bolt in the control system could result in an accident as serious as one caused by structural failure of a wing spar. However, it cannot be claimed that parts can be designed for infinite life; hence, a reasonable program of inspection, maintenance and replacement of parts in service is a necessary consideration.

Finally, airworthiness is dependent on the success of the designer in incorporating special safety features. For example, control systems are duplicated, or otherwise devised, in such a way that should failure occur to any one part a separate means will be available to permit accomplishing a safe landing. Control surfaces have extra hinges. Passenger seats are designed for crash load conditions and are provided with special safety belts (aft-facing seats have been proposed to enhance safety in the event of minor accidents). Fuel tanks are designed to withstand minor crashes without rupture. Windshields are specially designed to resist the impact of collision with birds in flight. Fuselages are specially designed to withstand loads caused by "ditching" the plane in a forced landing on water or land.

**Load Factors.**—The one most important criterion of strength of an aeroplane structure is its "applied load factor." Various other terms are used but by definition the load factor ($n$) is the amount by which, because of accelerations imposed in manoeuvres or turbulent air, the normal loads are increased in the ratio $L/W$, $L$ being the total wing lift and $W$ being the weight of the aeroplane. This ratio is one for level flight where $L=W$, and can be positive or negative in other conditions. By reference to basic aerodynamic equations for lift it can be seen that $L$ is directly proportional to angle of attack and the square of the speed ($V^2$). Thus, if the angle of attack is unchanged but the speed doubled, $n$ would be 4. Assuming the lift coefficient can also be doubled simultaneously by increasing the angle of attack, a further increase of load factor to a total value of 8 would be experienced.

It is theoretically impossible to provide enough strength to prevent failure of the structure. Fortunately, however, reasonable maximum values of $n$ can be specified for design purposes so that the likelihood of structural failure is remote during the life of the plane. The appropriate value can vary with the type of plane and its contemplated use; otherwise transport planes would be excessively heavy and uneconomical. For military fighters, $n$ may be as high as 10; for private planes, 4.0, and for commercial transports, 2.5 to 3.0 can be safely used. Fig. 10 shows in briefest possible detail the general relationship of load factor and speed for a typical plane

**Manoeuvring Loads.**—The loads induced by the pilot in manoeuvring the plane during turns, banks, stalls, pull-ups, rolls, etc., can be measured by means of an accelerometer. This instrument measures the load factor in terms of the normal acceleration caused by gravity, $g$. A $3g$ load factor is recorded when $\frac{L}{W}=3$ (neglecting secondary factors such as the lift on the tail surface, etc.). The outside outline "envelope" of fig. 10 is the safe structural limit manoeuvring strength of the plane. The pilot is required to so operate his plane as to stay inside this envelope at all times. For the example shown, he must not exceed a positive $3g$ or a negative $1g$ load factor up to the "never exceed" limit speed ($V_D$). For his part, the designer must make sure the wing, fuselage, tail surfaces and control systems are strong enough to withstand any combination of speed and "$n$" within the envelope.

Given the necessary control power and indifference to his own safety the pilot can, as before illustrated, impose quite high load factors in the plane structure. Most pilots "blank out" or temporarily lose control of certain senses, including sight, at less than $8g$. This consideration in itself provides a safety factor limiting practical application of extreme stresses, particularly for military fighter aircraft.

**Rough Air or Gust Loads.**—The sharp impact of rough or turbulent air on the plane produces "gust loads" which in principle are simply the aerodynamic effect of a rapid change of wing lift caused by change in the angle of attack. Vertical currents of air are responsible for this; the higher the vertical velocity of gust the higher the gust load factor produced. The designer can account for the effect of gusts in the manner shown by the 30 ft./sec. and 15 ft./sec. gust velocity broken lines of fig. 10. In these instances it will be noted that for a given gust velocity the higher the speed the greater the "bump" experienced. Planes are designed so that they can be safely flown at their cruising speed, $V_c$, in moderately rough air, which is usually associated with effective gust velocities of about 30 ft./sec. For very rough air it behooves the pilot to slow down even to a lower speed where much lower gust load factors will be the result.

**Ground Loads.**—In addition to being capable of taking stresses imposed under all flight conditions the structure must be designed

to withstand those developed in landings. Here again recourse is made to load factors; only in this instance the acceleration forces are applied to the landing wheels rather than the wings. Landing gears usually incorporate shock struts, which absorb the energy of impact associated with the landing by developing a resisting force which acts continuously during the compressing of the strut. A well-designed landing gear is one which will limit the applied forces to less than about 4*g* for commercial aircraft. Normal

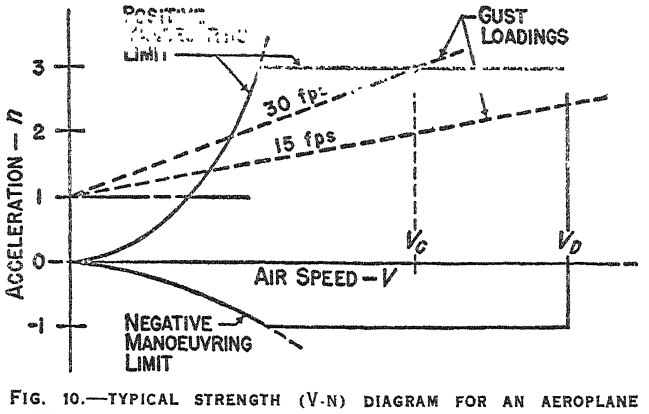



FIG. 10.—TYPICAL STRENGTH (V-N) DIAGRAM FOR AN AEROPLANE SHOWING MANOEUVRING AND GUST LOAD FACTOR CONDITIONS

landings are accomplished with much lower accelerations than this, but to take care of the worst cases of misjudgment and ground gust effects higher valves are used.

**Proof of Strength.**—Knowing the external loads on the plane structure, calculations are made of the stresses imposed on each part, bolt and rivet. Most structures are highly redundant and calculations can only be made with difficulty. Where doubt may exist as to the actual value of stresses or the path taken by loads, recourse is made to structural testing. Elaborate jigs are required to hold the structure and allow proper loading and observation of results. A major portion of the time and expense of development of a modern plane is spent in the structural testing program. As a result, any commercial plane which conforms to the official criterion of strength and has been certificated by the airworthiness authorities of the government can, if operated sensibly, carry passengers with complete safety.

## 10. MATERIALS USED IN CONSTRUCTION

**Early Composite Structures.**—The materials most commonly used for the main structural members of early aeroplanes were wood and steel, with a fabric covering for the wings. The wood used was chiefly spruce of the highest grade, and in many aeroplanes the whole of the main structure, with the exception of ties and joints, was of this material. Ties and the joints or fittings by which they were attached to the other members were generally of steel. Steel tubes were used in some parts, either, as in the undercarriage, because of their robustness, or, as in the control mechanism, because of their efficiency in transmitting torsion.

The cross section of the wing spars has the I section used in general structural engineering, though the thickness of the web and flanges is much larger in proportion to the over-all dimensions of the section than is usual in steel I girders.

Wood as a structural material suffers from the following disadvantages: (1) Suitable grades cannot be freely obtained. (2) When exposed to the atmosphere, particularly to large changes in temperature and humidity, wood deteriorates more rapidly than steel or other metals. (3) The external appearance of wood is often misleading as an indication of its internal condition. (4) Glue and wood screws cannot be entirely avoided, and both are sources of weakness and uncertainty. (5) When a wooden structure is involved in an accident, many of its members break completely and splinter, and the structure disintegrates, whereas metal members often merely bend, and an all-metal structure generally reserves much of its original shape. (6) Wood has no inherent resistance to fire. These disadvantages formed the chief incentive to the development of all-metal construction for planes.

**All-Metal Structures.**—The development of all-metal structures was originally mainly confined to replacing each of the wooden members of the composite structure described above by a metal member, using either steel or duralumin. In such a structure the load to be borne by each member was of a fairly simple character and could be estimated fairly closely. Hence, a comparison of the merits of a composite and an all-metal structure on these lines can be reduced to a comparison of typical members.

In small private aeroplanes welded steel tubular construction was still used quite extensively at mid-20th century. Wing spars might still be of wood, but more commonly they were of extruded aluminum alloy shapes. The exterior surfaces of wings, fuselage and tail surfaces might be either fabric or metal. When fabric was used it was usually a high-grade cotton fabric material laced onto the structure and finished with aircraft dope to give it tautness and air tightness. Metal coverings were made using a thin sheet aluminum alloy riveted construction. Streamlined steel or aluminum alloy tubing was used to form external bracing or struts for monoplane wings and landing gears.

For most planes the trend has been toward *monocoque* or semi-*monocoque* construction with the entire outer surface of the aeroplane of the metal stressed skin construction. Developments in the production of large, thin, uniform sheets of aluminum alloys, and in the art of welding and riveting, made desirable the *monocoque* type of construction in which the covering of the fuselage furnishes the strength. In the semi-*monocoque* type part of the stress is borne by the stressed skin and part by reinforcement.

Very high-speed aircraft require stiff structures for strength, rigidity and preservation of external contour. For such aircraft thick plate construction and large extruded and milled internal structural members are employed.

**Materials Used.**—The form and arrangement of internal structural members are dictated by the choice of materials, properties thereof and available methods for forming, fabricating and joining such materials. Aircraft materials fall into three principal classes: wood, steel and nonferrous metals. The accompanying table contains a brief listing of the most important of these, with appropriate weight and strength data for purposes of comparison. For many technical reasons a comparison of strength properties alone cannot be relied upon to indicate relative superiority; the particular application involved and other essential properties such as workability, fire resistance quality, heat insulating ability, surface hardness, relative rigidity, susceptibility to corrosion and availability of standard shapes enter into the choice.

Plastics had not yet reached the perfection needed for universal structural application at mid-century. Many nonprimary structural applications, however, are found for these materials in

*Typical Properties of Aircraft Materials*

| Material | Specific weight lb./cu in | Tension yield lb /sq in. | Tension ultimate lb /sq in. | Modulus of elasticity *E* |
|---|---|---|---|---|
| Wood | | | | |
| Spruce | 0 015 | — | 9,400 | 1 3x10⁶ |
| Mahogany plywood | 0 021 | — | 5,770 | 0 75x10⁶ |
| Ferrous metals | | | | |
| Low carbon steel(1,020) | 0 283 | 36,000 | 55,000 | 28x10⁶ |
| Chrome-moly (4,130) | 0 283 | 70,000 | 90,000 | 29x10⁶ |
| Stainless (¼ hard) (18-8) | 0 286 | 110,000 | 158,000 | 26x10⁶ |
| Aluminum alloys | | | | |
| 17 ST | 0 101 | 32,000 | 55,000 | 10 4x10⁶ |
| 24 ST | 0 100 | 46,000 | 65,000 | 10 5x10⁶ |
| 75 ST | 0 101 | 67,000 | 76,000 | 10 3x10⁶ |
| Magnesium | | | | |
| Mh | 0 0635 | 22,000 | 32,000 | 6 5x10⁶ |
| FS-1h | 0 0645 | 29,000 | 39,000 | 6 5x10⁶ |

flooring, partitions, radomes, ducts and transparent enclosures.

Castings and forgings of both steel and aluminum alloys are used extensively for fittings, hinge brackets and parts carrying relatively large concentrated loads.

Resistance to corrosion is of importance in aircraft structures. Dissimilar metals, where joined together, must be suitably insulated from one another by tape or zinc chromate primer to prevent

galvanic corrosion. Alclad possesses excellent natural resistance to weathering. Steel parts plated with zinc or cadmium or painted with zinc chromate primers also have good corrosion resistance.

The high strength of aircraft metals, despite light weight, is obtained through alloying certain constituents such as carbon, chromium, nickel, copper and zinc with steel, aluminum or magnesium. Proper treatment of these alloys is required, such as heat treatment, aging and cold-working (rolling), to develop the best properties New alloys were constantly developed to obtain improved strength properties both at low and high temperatures; examples of these included zirconium, cerium, titanium, etc.

**Allowable Stresses.**—What maximum stress will a particular strut, tubing, beam or bolt take before it will fail? How are such stresses determined? These questions require an answer before the stress analyst can be sure that the structural parts are safe. Aeroplane parts fail mostly under tension or compression loads. In the first case the matter is relatively simple since the important strength properties involved are the yield tensile strength and the ultimate tensile strength, the former being the stress at which plastic strain begins and the latter the stress at which rupture occurs. For all materials these values can be measured, using standard test specimens, in a tensile testing machine The accompanying table shows such typical values Knowing the allowable ultimate tensile stress of the material of the strut, tube or beam, the analyst can easily calculate the load which it can support in pounds by multiplying this stress by the appropriate cross-section area.

For compression allowable stress values the problem is much more complicated. Here failure may occur in a variety of ways; for example, by column buckling, by twisting or general instability and by local buckling or crushing. A long steel tube can fail under a very low end load by suddenly buckling laterally. If the load is relieved the tube will return to its original position unharmed. This is called column (or elastic) buckling. As the tube is shortened in length the allowable end load can be increased correspondingly; in practice, however, it will never reach in magnitude the load it can take in tension.

Thin sheets exhibit a similar characteristic by buckling readily under compressive loads. If the sheet is reinforced by attaching stringers lengthwise of the sheet, or by corrugating it, higher compressive loads can be carried before it will buckle. This is the principle of stiffened skin construction used in aircraft fabrication, making it possible to use lightweight thin metal materials. A great variety of types and shapes of stiffened structural elements are used by manufacturers. The allowable stresses for such elements are largely determined from a number of sheet stringer combination panel tests. Results of the tests, supplemented by theoretical methods, are then used to establish criteria which accurately predict failing loads for comparable elements of the aircraft structure.

There are many other stresses which are of importance to designers, among them allowable shear and bearing stresses of materials for use in determining the strength of rivet and bolt connections. Fatigue stresses, or the ability of a material to withstand cyclical repetition of load, are also important for determination of the useful life of a part in service.

**Joining of Materials.**—The aeroplane designer is faced with the problem of transforming materials which he procures in the form of flat sheet, bars, round tubing or extruded shapes such as angles, channels, zees, etc., into parts of a plane. This requires forming of pieces, fitting to assembly jigs and joining the parts together. The three most common aircraft processes of joining parts are welding, riveting and bonding.

Welded construction is employed extensively for the joining of steel parts. The most common type is oxyacetylene torch welding, although electric resistance and arc welding are also used. Parts which require heat treatment for increased strength must be furnace-heated subsequent to welding and quenched under correct temperature conditions Since heat destroys the strength properties of aluminum alloys, only certain such materials can be satisfactorily torch-welded, and this by skilled operators under controlled conditions. Spot welding of alclad aluminum alloys has, however, been successfully employed. Spot welding, using automatic machines, is used also for fabricating parts made of stainless steel materials.

The most common method of joining high-strength aluminum alloy parts is by riveting This requires the careful fitting of parts, drilling of rivet holes and, usually, manual driving of rivets with air guns. On exterior surfaces where a smooth surface is necessary, flush riveting is employed; *i.e*, the outside head of the rivet fits into a countersunk hole in the sheet. Rivet materials must be soft enough to drive without cracking and yet, because of the hardening effect of the working received in driving, it must develop the required strength to carry the required loads through the joint.

Bonding involves joining parts (exclusive of heat bonding by brazing) by using a plastic adhesive between surfaces. By this means it is possible to join not only like materials but materials such as aluminum alloy sheet to wood, rubber or plastic materials.

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(B. L S; X)

**AEROTHERAPEUTICS.** In addition to the general use of open air and sunshine, there are several particular ways of using air for therapeutic purposes. Thus, oxygen-enriched air is used for those made ill through breathing irritant gases such as were used in warfare.

These gases evoke oedema of the lungs and danger of suffocation through want of oxygen. So, too, in cases of pneumonia, shock and failing circulation, oxygen inhalation is useful. It is administered either by a mask or in a special chamber in which the patient is put. In the latter case great precaution must be taken against the danger of fire.

Oxygen containing 5% of carbon dioxide provokes deep breathing, and is useful in cases when the lungs require expanding, as after operations for empyema, when hypostatic congestion of the lungs threatens, and in cases of poisoning by carbon monoxide, as in ordinary coal gas poisoning, etc. This mixture is particularly useful for breathing during induction of and after anaesthesia with ether, since the deep respiration induces anaesthesia quickly, and washes the ether out of the body at the end of the anaesthetic period. The breathing of nitrous oxide and oxygen in a compressed air chamber at half an atmosphere extra pressure gives deep and safe anaesthesia.

Certain dusts in the air act as irritants to those affected with hay fever and asthma; *e.g.*, the pollen of plants, spores of aspergillus mould. It has been found possible to relieve such patients by sending them to high mountains.

In a mercurial or sulphur bath, the patient, enveloped in a sheet, sits on a chair beneath which a lamp is placed both to volatilize the drug and produce a steamy atmosphere. The vapour is absorbed by the skin. This treatment is used for syphilis and also for scabies and other affections of the skin. (*See* THERAPEUTICS.)

Air at a low pressure is used locally for cupping and thus producing local congestion, the blood being drawn into the part to which the cupping apparatus is applied at the expense of other organs. A similar result is got by local application of heat, poultices, etc. In operations where the chest cavity is opened air is blown into the lungs through a tube introduced through the larynx in order to keep the lungs distended.

**Ozonized Air.**—Ozonized air has been used in treatment of tuberculosis and wounds. Ozone is an irritant to the lungs and can be used safely only in very weak concentrations; *e.g.*, in a concentration just perceptible to the smell. It takes away the power to smell bad odours, but otherwise has no valuable properties which have been proved. Its chief use, therefore, is for deodorizing offensive smells. (L. E. H.)

*See* "Aerotherapeutics," *American Journal of Physical Therapy,* vol. 3 (1926–27).

**AERSCHOT, PHILIPPE DE CROY,** DUKE OF (1526–1595), prince of Chimay, governor general of Flanders, was born

at Valenciennes, and inherited the estates of the ancient and wealthy family of Croy. He was appointed governor of the citadel of Antwerp when the Spanish troops withdrew in 1577. After a period of vacillation he deserted Don John toward the end of that year.

Jealous of the prince of Orange, he was then the head of the party which induced the archduke Matthias (afterward emperor) to undertake the sovereignty of the Netherlands, and soon afterward was appointed governor of Flanders by the state council.

A strong party, including the burghers of Ghent, distrusted the new governor, and Aerschot, who was taken prisoner during a riot at Ghent, was only released on promising to resign his office.

He then sought to regain the favour of Philip of Spain, and having been pardoned by the king in 1580 shared in the government of the Netherlands; but he refused to serve under the count of Fuentes when he became governor general in 1594, and retired to Venice. He died on Dec. 11, 1595.

*See* J. L Motley, *The Rise of the Dutch Republic.*

**AERTSZEN** (or AARTSEN), **PIETER** (1507–1573), called "long Peter" on account of his height, Dutch historical painter, was born and died at Amsterdam. When a youth he distinguished himself by painting homely scenes, in which he reproduced articles of furniture, cooking utensils, etc., with marvellous fidelity. An excellent specimen of his style on a small scale, a picture of the Crucifixion, may be seen in the Antwerp museum. Aertszen was a member of the Academy of St. Luke, in the books of which he is entered as *Langhe Peter, schilder.* Three of his sons attained to some note as painters.

**AESCHINES** (5th century B.C.), an Athenian philosopher and orator and a friend of Socrates. Diogenes Laertius preserves a tradition that it was he, not Crito, who offered to help Socrates to escape from prison. He was always a poor man He started a perfumery shop in Athens on borrowed capital, became bankrupt and retired to the Syracusan court. According to Diogenes Laertius (ii, 61), Plato, then at Syracuse, pointedly ignored Aeschines, but this does not agree with Plutarch *De adulatore et amico* (c. 26). On the expulsion of the younger Dionysius, Aeschines returned to Athens, and, finding it impossible to profess philosophy publicly owing to the contempt of Plato and Aristotle, was compelled to teach privately. Besides forensic speeches, noted for their purity of style, he wrote several philosophical dialogues: (1) *Concerning virtue, whether it can be taught;* (2) *Eryxias, or Erasistratus: concerning riches, whether they are good;* (3) *Axiochus: concerning death, whether it is to be feared,* but those extant are not genuine remains.

J. le Clerc made a Latin translation of them, with notes and several dissertations, entitled *Silvae Philologicae,* and they were edited by S. N. Fischer (Leipzig, 1786) and K. F. Hermann, *De Aeschin. Socrat. relig.* (Göttingen, 1850). The genuine dialogues appear to have been marked by the Socratic irony; an amusing passage is quoted by Cicero in the *De inventione* (i, 31). *See* also R. Hirzel, *Der Dialog,* i, 129–140 (1895); T. Gomperz, *Greek Thinkers,* vol. iii, p. 342, English trans. by G. G. Berry (London, 1905).

**AESCHINES** (389–314 B.C.), Athenian orator, the political opponent of Demosthenes. Aeschines and Demosthenes were both members of the first embassy to Philip (February–March 346 B.C.).

Philip's envoys appeared in the assembly on April 15 and 16, and between these two meetings Aeschines appears to have been won over to Philip's interest; on April 15 he refused, with Demosthenes, to accept a clause excluding Phocis; on April 16 he supported a peace in which the question was left vague. The same ambassadors went to administer the oaths to Philip, but, after so delaying on their journey that Philip had time to make conquests in Thrace, Philocrates and Aeschines (outvoting Demosthenes), allowed him to exclude the Phocians. But on his return Aeschines falsely assured the assembly that he had private information that Philip meant to support Phocis. The Athenians believed him and Phocis, left without support, surrendered.

In 345 Demosthenes accused Aeschines of misconduct, but Aeschines saved himself by an attack on Demosthenes' supporter (in *Timarchum*).

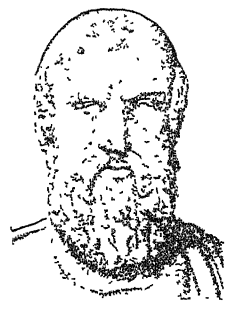
In 343 Demosthenes renewed the attack, and Aeschines secured a bare acquittal (*De Falsa Legatione*).

In 340 war broke out again with Philip, and thanks to Aeschines, who stirred up a sacred war in 339, he managed to enter Greece unopposed, as general of the Amphictyonic forces. Athens and Thebes, united by Demosthenes, resisted desperately, but were decisively defeated at Chaeroneia (338).

Aeschines' party secured favourable terms from Philip, and prosecuted Demosthenes on various charges, but the Athenians loyally supported him, and in 336 it was proposed to crown him for public services. Aeschines brought a *graphē paranomōn* against the proposer (in *Ctesiphontem*), but the case was not tried till 330. Demosthenes' speech, "On the Crown" (a vindication of his whole policy), secured the condemnation of Aeschines, who withdrew to Rhodes.

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**AESCHYLUS** (525–456 B.C.), Greek poet, the first of the only three Attic tragedians of whose work entire plays survive, and in a very real sense the founder of the Greek drama, was born at Eleusis in 525 B.C. His father, Euphorion, belonged to the "Eupatridae" or old nobility of Athens, as we know on the authority of the short *Life* of the poet given in the Medicean manuscript (*see* note on "authorities" in the *Bibliography*). According to the same tradition he took part as a soldier in the great struggle of Greece against Persia; and was present at the battles of Marathon, Artemisium, Salamis and Plataea, in the years 490–479.



AESCHYLUS, FATHER OF THE GREEK DRAMA
Head now in the Capitoline Museum, Rome, believed to be that of Aeschylus, probably of about the 5th century B.C.

At least one of his brothers, Cynaegirus, fought with him at Marathon, and was killed in attempting a conspicuous act of bravery, and the brothers' portraits found a place in the national picture of the battle which the Athenians set up as a memorial in the Stoa Poecile (or "pictured porch") at Athens.

The vigour and loftiness of tone which mark Aeschylus' poetic work were results not only of his native genius and gifts, powerful as they were, but also of the personal share he took in the great actions of a heroic national uprising.

In the same way, the poet's brooding thoughtfulness on deep questions—the power of the gods, their dealings with man, the dark mysteries of fate, the future life in Hades—though largely a result of his turn of mind and temperament, was doubtless connected with the place where his childhood was passed. Eleusis was the centre of the most famous worship of Demeter, with its processions, ceremonies, mysteries, impressive spectacles and nocturnal rites; and these were intimately connected with the Greek beliefs about the human soul and the underworld.

His dramatic career began early and continued for more than 40 years.

In 499, his 26th year, he first exhibited at Athens; and his last work, acted during his lifetime at Athens, was the trilogy of the *Oresteia,* exhibited in 458. The total number of his plays is stated by Suidas to have been 90, and the 7 extant plays, with the dramas named or nameable which survive only in fragments, amount to more than 70, so that Suidas' figure is probably based on reliable tradition. It is well known that in the 5th century B.C. each exhibitor at the tragic contests produced four plays, and Aes-

chylus must therefore have competed (between 499 and 458) more than 20 times, or once in two years. His first victory is recorded in 484, 15 years after his earliest appearance on the stage; but in the remaining 26 years of his dramatic activity at Athens he was successful at least 12 times. This clearly shows that he was the most commanding figure among the tragedians of 500–458, and for more than half that time was usually the victor in the contests. Perhaps the most striking evidence of his exceptional position among his contemporaries is the well-known decree passed shortly after his death that whosoever desired to exhibit a play of Aeschylus should "receive a chorus"; *i.e.*, be officially allowed to produce the drama at the Dionysia.

The existence of this decree, mentioned in the *Life*, is strongly confirmed by two passages in Aristophanes: first in the prologue of the *Acharnians* (which was acted in 425, 31 years after the poet's death), where the citizen, grumbling about his griefs and troubles, relates his great disappointment, when he took his seat in the theatre "expecting Aeschylus," to find that when the play came on it was Theognis; and secondly in a scene of the *Frogs* (acted 405 B.C.), where the throne of poetry is contested in Hades between Aeschylus and Euripides, the former complains (*Frogs*, 866) that "the battle is not fair, because my own poetry has not died with me, while Euripides' has died, and therefore *he will have it with him to recite*"—a clear reference, as the scholiast points out, to the continued production at Athens of Aeschylus' plays after his death.

Apart from fables, guesses and blunders, of which a word is said below, the only other incidents recorded of the poet's life that deserve mention are connected with his Sicilian visits, and the charge preferred against him of revealing the "secrets of Demeter."

This tale is briefly mentioned by Aristotle (*Ethics*, iii. 2), and a late commentator (Eustratius, 12th century) quotes from one Heracleides Ponticus the version which may be briefly given as follows:

The poet was acting a part in one of his own plays, where there was a reference to Demeter. The audience suspected him of revealing the inviolable secrets, and rose in fury; the poet fled to the altar of Dionysus in the orchestra and so saved his life for the moment; for even an angry Athenian crowd respected the inviolable sanctuary.

He was afterward charged with the crime before the Areopagus, and his plea "that he did not know that what he said was secret" was accepted by the court and secured his acquittal. The commentator adds that the prowess of the poet (and his brother) at Marathon was the real cause of the leniency of his judges. The story was afterward developed, and embellished by additions; but as the main fact seems accepted by Aristotle, it is probably authentic in the above shape.

As to his foreign travel, the suggestion has been made that certain descriptions in the *Persae*, and the known fact that he wrote a trilogy on the story of the Thracian king Lycurgus, persecutor of Dionysus, seem to point to his having a special knowledge of Thrace, which makes it likely that he had visited it. This, however, remains at best a conjecture. For his repeated visits to Sicily, on the other hand, there is conclusive ancient evidence.

Hiero I, tyrant of Syracuse, who reigned about 12 years (478–467), and among other efforts at magnificence invited to his court famous poets and men of letters, had founded a new town, Aetna, on the site of Catana which he captured, expelling the inhabitants. Among his guests were Aeschylus, Pindar, Bacchylides and Simonides. About 476 Aeschylus was entertained by him, and at his request wrote and exhibited a play called *The Women of Aetna* in honour of the new town. He paid a second visit about 472, the year in which he had produced the *Persae* at Athens, and the play is said to have been repeated at Syracuse at his patron's request.

Hiero died in 467, the year of the *Seven against Thebes;* but after 458, when the *Oresteia* was exhibited at Athens, we find the poet again in Sicily for the last time. In 456 he died and was buried at Gela; on his tomb was placed an epitaph in two elegiac couplets saying: "Beneath this stone lies Aeschylus, son of Euphorion, the Athenian, who perished in the wheat-bearing land of Gela; of his noble prowess the grove of Marathon can speak, or the long-haired Persian who knows it well." The authorship of this epitaph is uncertain, as the *Life* says it was inscribed on his grave by the people of Gela, while Athenaeus and Pausanias attribute it to Aeschylus. Probably most people would agree that only the poet himself could have praised the soldier and kept silent about the poetry.

Of the marvellous traditions which gathered round his name little need be said. Pausanias' tale, how Dionysus appeared to the poet when a boy, asleep in his father's vineyard, and bade him write a tragedy—or the account in the *Life*, how he was killed by an eagle letting fall on his head a tortoise whose shell the bird was unable to crack—clearly belong to the same class of legends as the story that Plato was son of Apollo, and that a swarm of bees settled upon his infant lips as he lay in his mother's arms Less supernatural, but hardly more historical, is the statement in the *Life* that the poet left Athens for Sicily in consequence of his defeat in the dramatic contest of 468 by Sophocles; or the alternative story of the same authority that the cause of his chagrin was that Simonides' elegy on the heroes slain at Marathon was preferred to his own.

Apart from the inherent improbability of such pettiness in such a man, neither story fits the facts, for in 467, the next year following Sophocles' success, it is known that Aeschylus won the prize of tragedy with the *Septem;* and the Marathon elegy must have been written in 490, 14 years before his first visit to Sicily.

**Aeschylus' Plays.**—In passing from Aeschylus' life to his work, we have obviously far more trustworthy data, in the 7 extant plays (with the fragments of more than 70 others), and particularly in the invaluable help of Aristotle's *Poetics*. The real importance of our poet in the development of the drama (*see* DRAMA: *Greek*) as compared with his predecessors is shown by the fact that Aristotle, in his brief review of the rise of tragedy (*Poetics*, iv, 13), names no one before Aeschylus.

He recognizes, it is true, a long process of growth, with several stages, from the dithyramb to the drama; and it is not difficult to see what these stages were. The first step was the addition to the old choric song of an interlude spoken, and in early days improvised, by the leader of the chorus (*Poetics*, iv, 12). The next was the introduction of an actor (literally, an "answerer"), to reply to the leader; and thus we get dialogue added to recitation.

The "answerer" was at first the poet himself (Aristotle, *Rhetoric*, iii, 1). This change is traditionally attributed to Thespis (533 B.C.), who is, however, not mentioned by Aristotle. The mask, to enable the actor to assume different parts, by whomsoever invented, was in regular use before Aeschylus' day. The third change was the enlarged range of subjects. The lyric dithyramb tales were necessarily about Dionysus, and the interludes had, of course, to follow suit. Nothing in the world so tenaciously resists innovation as religious ceremony, and it is interesting to learn that the Athenian populace (then, as ever, eager for "some new thing") nevertheless opposed at first the introduction of other tales:

But the innovators won, or otherwise there would have been no Attic drama.

In this way, then, to the original lyric song and dances in honour of Dionysus was added a spoken (but still metrical) interlude by the chorus leader, and later a dialogue with one actor (at first the poet), whom the mask enabled to appear in more than one part.

Nevertheless, all the evidence points to the fact that in the development of the drama Aeschylus was the decisive innovator.

The two things that were important, when the 5th century began, if tragedy was to realize its possibilities, were (1) the disentanglement of the dialogue from its position as an interlude in an artistic and religious pageant that was primarily lyric; and (2) its general elevation of tone. Aeschylus, as we know on the express authority of Aristotle (*Poetics*, iv, 13), achieved the first by the introduction of the second actor; and though he did not begin the second he gave to it the decisive impulse and consum-

mation by the overwhelming effect of his serious thought, the stately splendour of his style, his high dramatic purpose, and the artistic grandeur and impressiveness of the construction and presentment of his tragedies.

As to the importance of the second actor no argument is needed. The interacting personal influences of different characters on each other are indispensable to anything that can be called a play, as we understand the word; and, without two "personae dramatis" at the least, the drama in the strict sense is clearly impossible. The number of actors was afterwards increased; but to Aeschylus is due the essential step; and therefore, as was said above, he deserves, in a very real sense, to be called the founder of Athenian tragedy.

Of the seven extant plays, *Supplices, Persae, Septem contra Thebas, Prometheus, Agamemnon, Choephoroe* and *Eumenides,* five can be dated with certainty, as the archon's name is preserved in the Arguments; and the other two approximately. The dates rest, in the last resort, on the *didaskalia,* or the official records of the contests, of which Aristotle (and others) compiled catalogues; and some actual fragments have been recovered. The order of the plays is probably that given above; and certainly the *Persae* was acted in 472, *Septem* in 467, and the trilogy in 458. The *Supplices* is generally regarded as the oldest; and the best authorities tend to place it not far from 490. The early date is strongly confirmed by three things: the extreme simplicity of the plot, the choric (instead of dramatic) opening, and the fact that the percentage of lyric passages is 54, or the highest of all the seven plays. The chief doubt is in regard to *Prometheus,* but the very low percentage of lyrics (only 27, or roughly a quarter of the whole), and still more the strong characterization, a marked advance on anything in the first three plays, point to its being later than any except the trilogy, and suggest a date somewhere about 460, or perhaps a little earlier. A few comments on the extant plays will help to indicate the main points of Aeschylus' work.

**Supplices.**—The exceptional interest of the *Supplices* is due to its date. Being nearly 20 years earlier than any other extant play, it furnishes evidence of a stage in the evolution of Attic drama which would otherwise have been unrepresented It probably resembles in general structure the lost works of Choerilus, Phrynichus, Pratinas and the 6th century pioneers of drama.

The plot is briefly as follows: the 50 daughters of Danaus (who are the chorus), betrothed by Aegyptus (their father's brother) to his 50 sons, flee with Danaus to Argos, to escape the marriage. They claim the protection of the Argive king, Pelasgus; and he (by a pleasing anachronism) refers the matter to the people, who agree to protect the fugitives. The pursuing fleet of suitors is seen approaching; the herald arrives, orders off the cowering Danaids to the ships and finally attempts to drag them away. Pelasgus interposes with a force, drives off the Egyptians and saves the suppliants. Danaus urges them to prayer, and the grateful chorus pass away to the shelter offered by their protectors.

It is clear that we have here the drama just developing out of the lyric pageant. The interest still centres round the chorus. Character and plot—the two essentials of drama—are both here rudimentary. The play is a single situation. It should not be forgotten, indeed, that the play is one of a trilogy—an act, therefore, rather than a complete drama. But we have only to compare it with those later plays of which the same is true, to see the difference. Even in a trilogy, each play is a complete whole in itself, though also a portion of a larger whole.

**Persae.**—The next play that has survived is the *Persae,* the only extant Greek historical drama. The plot is still severely simple, though more developed than that of the *Supplices.* The opening is still lyric, and the first quarter of the play brings out, by song and speech, the anxiety of the people and queen as to the fate of Xerxes' huge army. Then comes the messenger with the news of Salamis, including a description of the sea-fight itself which can only be called magnificent. The play is not a tragedy in the true Greek sense; its real aim is not the "pity and terror" of the developed drama; it is the triumphant glorification of Athens, the exultation of the whole nation gathered in one place, over the ruin of their foe; and one effective incident is the raising of Darius's ghost, and his prophecy of the disastrous battle of Plataea. But in the ghost's revelations there is a mixture of audacity and naïveté, characteristic at once of the poet and the early youth of the drama.

**Septem Contra Thebas.**—Three years later came the Theban tragedy, which is (like the *Supplices*) one of a connected series, dealing with the evil fate of the Theban house, and traces the fate through three generations, Laius, Oedipus and the two sons who die by each other's hands in the fight for the Theban sovereignty. This family fate, where one evil deed leads to another after many years, is a larger conception, strikingly suited to Aeschylus' genius, and constitutes a notable stage in the development of the Aeschylean drama. In the last extant work, the *Oresteia,* the poet traces the tragedy of the Pelopid family, from Agamemnon's first sin to Orestes' vengeance and purification. And the names of several lost plays point to similar handling of the tragic trilogy.

The *Seven against Thebes* is the last play of its series; and again the plot is severely simple Father and grandfather have both perished miserably; and the two princes both claim the kingdom. Eteocles has driven out Polyneices, who fled to Argos, gathered a host under seven leaders (himself being one), and when the play opens has begun the siege of his own city. The king appears, warns the people, chides the clamour of women, appoints seven Thebans, including himself, to defend the seven gates, departs to his post, meets his brother in battle and both are killed. The other chieftains are all slain, and the enemy beaten off. The two dead princes are buried by their two sisters, who alone are left of the royal house.

Various signs of the early drama are here manifest. Half the play is lyric; there is no complication of plot; the whole action is recited by messengers; and the predicted mutual slaughter of the princes is brought about by no accidental stroke of destiny, but by the choice of the king, Eteocles himself. On the other hand, the opening is no longer lyric (like the two earlier plays) but dramatic; the main scene, where the king appoints the seven defenders, must have been an impressive spectacle. One novelty should not be overlooked. There is here the first passage of *dianoia,* or general reflection of life, which later became a regular feature of tragedy. Eteocles muses on the fate which involves an innocent man in the company of the wicked so that he shares unjustly their deserved fate (*Theb.* 597–608). The whole part of Eteocles shows a new effort of the poet to draw character, which may have something to do with the rise of Sophocles, who in the year before (468) won the prize of tragedy. There remain only the *Prometheus* and the *Oresteia,* which show such marked advance that (it may almost be said) when we think of Aeschylus it is these four plays we have in mind.

**Prometheus.**—The Prometheus-trilogy consisted of three plays: *Prometheus the Fire-bringer, Prometheus Bound, Prometheus Unbound.* The two last necessarily came in that order; the *Fire-bringer* is probably the first of the trilogy. That Prometheus sinned against Zeus, by stealing fire from heaven; that he was punished by fearful tortures for ages; that he was finally reconciled to Zeus and set free—all this was the ancient tale indisputably. Those who hold the *Fire-bringer* (Πυρφόρος) to be the final play, conjecture that it dealt with the establishment of the worship of Prometheus under that title, which is known to have existed at Athens. But the other order is on all grounds more probable; it keeps the natural sequence—crime, punishment, reconciliation, which is also the sequence in the *Oresteia.* And if the reconciliation was achieved in the second play, no scheme of action sufficing for the third drama seems even plausible.[1]

The play that survives is a poem of unsurpassed force and impressiveness. Nevertheless, from the point of view of the

[1]The *Eumenides* is quoted as a parallel, because there the establishment of this worship at Athens concludes the whole trilogy; but it is forgotten that in *Eumenides* there is much besides—the pursuit of Orestes, the refuge at Athens, the trial, the acquittal, the conciliation by Athena of the Furies; while here the story would be finished before the last play began.

development of drama, there seems at first sight little scope in the story for the normal human interest of a tragedy, since the actors are all divine, except Io, and between the opening where Prometheus is nailed to the Scythian rock, and the close where the earthquake engulfs the rock, the hero and the chorus, action in the ordinary sense is *ipso facto* impossible. This is just the opportunity for the poet's bold inventiveness and fine imagination.

Oceanus, the well-meaning palavering old mentor, and Hermes, the blustering and futile jack-in-office, gods though they be, are vigorous, audacious and very human character-sketches; the soft entrance of the consoling nymphs is unspeakably beautiful; and the prophecy of Io's wanderings is a striking example of that new keen interest in the world outside which was felt by the Greeks of the 5th century, as it was felt by the Elizabethan English in a very similar epoch of national spirit and enterprise 2,000 years later. Thus, though dramatic action is by the nature of the case impossible for the hero, the visitors provide real drama.

Another important point in the development of tragedy is what we may call the "balanced issue" The hero is both a victim and a rebel. He is punished for his benefits to man; but though Zeus is tyrannous, the hero's reckless defiance is shocking to Greek feeling. As the play goes on, this is subtly indicated by the attitude of the chorus. They enter overflowing with pity. They are slowly alienated by the hero's impiety; but they decline, at the last crisis, the mean advice of Hermes to desert Prometheus; and in the final crash they share his fate.

**Oresteia.**—The last and greatest work of Aeschylus is the *Oresteia,* which also has the interest of being the only complete trilogy preserved to us. As in *Prometheus,* the plot, at first sight, is such that the conditions of drama seem to exclude much development in character-drawing. The gods are everywhere at the root of the action. The inspired prophet, Calchas, has demanded the sacrifice of the king's daughter, Iphigeneia, to appease the offended Artemis. The inspired Cassandra, brought in as a spear-won slave from conquered Troy, reveals the murderous past of the Pelopid house, and the imminent slaughter of the king by his wife. Apollo orders the son, Orestes, to avenge his father by killing the murderess, and protects him when after the deed he takes sanctuary at Delphi. The Erinyes ("Furies") pursue him over land and sea; and at last Athena gives him shelter at Athens, summons an Athenian council to judge his guilt, and when the court is equally divided gives her casting vote for mercy. The last act ends with the reconciliation of Athena and the Furies; and the latter receive a shrine and worship at Athens, and promise favour and prosperity to the great city. The scope for human drama seems deliberately restricted by such a story so handled. Nevertheless, the growth of characterization is not only visible but remarkable. Clytaemnestra is one of the most powerfully presented characters of the Greek drama. And there is one other noticeable point. In this trilogy, Aeschylus, for the first time, has attempted some touches of character in two of the humbler parts, the watchman in *Agamemnon,* and the nurse in the *Choephoroe.* These two are veritable figures drawn from contemporary life; and though both appear only once, the innovation is most significant, and especially as adapted by Aeschylus.

**Aeschylus' Characteristics.**—It remains to say a word on two more points: the religious ideas of Aeschylus and some of the main characteristics of his poetry. The religious aspect of the drama in one sense was prominent from the first. But the new spirit imported by the genius of Aeschylus was religious in a profounder meaning of the term. The sadness of human lot, the power and mysterious dealings of the gods, their terrible and inscrutable wrath and jealousy (*aga* and *phthonos*), their certain vengeance upon sinners, all the more fearful if delayed—such are the poet's constant themes, especially in the *Oresteia.* And at times, particularly in the *Trilogy,* in his reference to the divine power of Zeus, he almost approaches a stern and sombre monotheism

One specially noteworthy point in the *Agamemnon* is his explicit repudiation of the common Hellenic view that prosperity brings ruin. In other places he seems to share the feeling, but here (*Ag.* 730) he goes deeper, and declares that it is not ὄλβος but always wickedness that brings about men's fall. All through there is a recurring note of *fear* in his view of man's destiny In one remarkable passage of the *Eumenides* (517–525) this fear is extolled as a moral power which ought to be enthroned in men's hearts, to deter them from impious acts or from the pride that impels them to such sins.

Of the poetic qualities of Aeschylus' drama and diction, both in the lyrics and the dialogue, the briefest word must here suffice. He is everywhere distinguished by grandeur and power of conception, presentation and expression, and most of all in the latest works, the *Prometheus* and the *Trilogy* He is pre-eminent in depicting the slow approach of fear, as in the *Persae;* the imminent horror of impending fate, as in the broken cries and visions of Cassandra in the *Agamemnon* (1072–1177), the long lament and prayers to the nether powers in the *Choephoroe* (315–478), and the gradual rousing of the slumbering Furies in the *Eumenides* (117–139) The fatal end in these tragedies is foreseen, but the effect is due to its measured advance, to the slowly darkening suspense which no poet has more powerfully rendered Again, he is a master of contrasts, as when the floating vision of consoling nymphs appears to the tortured Prometheus (115–135); or the unmatched lyrics which tell (in the *Agamemnon,* 228–247) of the death of Iphigeneia; or the vision of his lost love that the night brings to Menelaus (410–426). And not least noticeable is the extraordinary range, force and imaginativeness of his diction. One example of his lyrics may be given which will illustrate more than one of these points. It is taken from the lament in the *Septem,* sung by the chorus and the two sisters, while following the funeral procession of the princes (*Sept.* 854–860):—

> Nay, with the wafting gale of your sighs, my sisters,
> Beat on your heads with your hands the stroke as of oars,
> The stroke that passes ever across Acheron,
> Speeding on its way the black-robed sacred bark,—
> The bark Apollo comes not near,
> The bark that is hidden from the sunlight—
> To the shore of darkness that welcomes all! (A. Sı.)

BIBLIOGRAPHY.—*Authorities:* The chief authority for the text is a single ms. at Florence, of the early 11th century, known as the Medicean or M., written by a professional scribe and revised by a contemporary scholar, who corrected the copyist's mistakes, added the scholia, the arguments and the *dramatis personae* of three plays (*Theb., Agam., Eum.*), and at the end of the *Life of Aeschylus* and the *Catalogue* of his dramas. The ms. has also been further corrected by later hands. In 1896 the Italian Ministry of Public Instruction published the ms. in photographic facsimile, with an instructive preface by Signor Rostagno. Besides M. there are some eight later mss. (13th to 15th century), and numerous copies of the three select plays (*Sept., Pers., Prom.*) which were most read in the later Byzantine period. These later mss. are of little value.

*Editions.*—The three first printed copies (Aldine, 1518; Turnebus and Robortello, 1552) give only those parts of *Agamemnon* found in M., from which ms. some leaves were lost; in 1557 the full text was restored by Vettori (Victorius) from later mss. After these four, the chief editions of the seven plays were those of Schütz, Porson, Butler, Wellauer, Dindorf, Bothe, Ahrens, Paley, Hermann, Hartung, Weil, Merkel, Kirchhoff and Wecklein. Editions of separate plays, special studies, etc. Wilamowitz-Moellendorf, Enger, Conington, Blaydes, Cobet, Meineke, Madvig, Ellis, W. Headlam, Davies, Tucker, Verrall, Haigh and Hoernle. The *Fragments* have been edited by Nauck and also by Wecklein. The Aeschylean staging is discussed in Albert Müller's *Lehrbuch der griechischen Bühnenalterthümer;* in "Die Bühne des Aeschylos," by Wilamowitz (*Hermes,* xxi.); in Smith's *Dict. of Antiquities,* art. "Theatrum" (R. C. Jebb); in Dörpfeld and Reisch (*Das griechische Theater*), Haigh's *Attic Theatre,* and Gardner and Jevons' *Manual of Greek Antiquities.* English verse translations: *Agamemnon,* Milman and R. Browning; *Oresteia, Suppliants, Persae, Seven against Thebes, Prometheus Vinctus,* by E. D. A. Morshead; *Prometheus,* E. B. Browning; the whole seven plays, Lewis Campbell. *Oresteia* by G. Murray, by R. C. Trevelyan, by G. M. Cookson; prose translation by W. G. and C. E. S. Headlam.

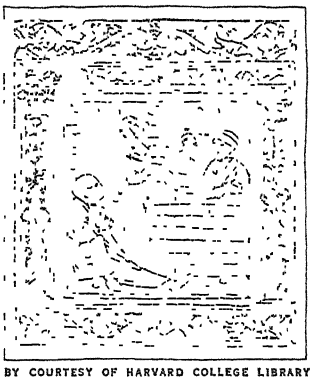
**AESCULAPIUS,** the Latin form of ASKLEPIOS (Ἀσκλήπιος) the name of the Greek god of medicine, the son of Apollo and the nymph Coronis. He probably came from Thessaly. The centaur Cheiron taught him the art of healing. At length Zeus, who, being afraid that he might render all men immortal, slew him with a thunderbolt (Apollodorus iii. 10; Pindar, *Phthia,* 3; Diod. Sic. iv.

71) Homer mentions him as a skilful physician, whose sons, Machaon and Podaleirius, are physicians in the Greek camp before Troy (*Iliad,* ii. 731). Temples were erected to Asklepios in many parts of Greece, near healing springs or on high mountains. The practice of sleeping (*incubatio*) in these sanctuaries was very common, it being supposed that the god effected cures or prescribed remedies to the sick in dreams All who were healed offered sacrifice (especially a cock) and hung up votive tablets, recording their names, their diseases, and the manner in which they had been cured Many of these tablets have been discovered at Epidaurus, the god's most famous shrine Herodas (*Mimes,* 4) gives a description of one of his temples, and of the offerings made to him The cult of Asklepios was introduced into Rome by order of the Sibylline books (293 B.C.), to avert a pestilence The god was fetched from Epidaurus in the form of a snake and a temple assigned him on an island in the Tiber (Livy x. 47; Ovid, *Metam* xv. 622). Asklepios is commonly represented standing, dressed in a long cloak, with bare breast, his usual attribute is a club-like staff with a serpent coiled round it. He is often accompanied by Telesphorus, the boy genius of healing, and his daughter, Hygieia, the goddess of health. Votive reliefs representing such groups have been found near the temple of Asklepios at Athens.

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**AESERNIA** (mod. *Isernia,* Italy), Samnite town 58 mi. N E. of Beneventum on the road to Corfinium, at the junction of a road past Venafrum to the Via Latina. These routes are all followed by railways to Campobasso, Sulmona and Caianello. A Roman colony from 263 B.C., it became the headquarters of the Italian revolt after the loss of Corfinium, and was only recovered by Sulla at the end of the war, in 80 B.C. Massive ancient walls serve as foundation to modern ones.

**AESOP** (Gr. Αἴσωπος), author of *Fables* about animals, generally with a didactic purpose, which have given their name to a whole class of stories, is supposed to have lived from about 620 to 560 B.C. The place of his birth is uncertain. He was the slave of Iadmon of Samos and met with a violent death at the hands of the inhabitants of Delphi. When a pestilence came upon them, the Delphians offered [illegible] for his death, and the [illegible] claimed by Iadmon, grandson of his old master. Herodotus, who is authority for this (ii. 134), does not state the cause of Aesop's death; various reasons are assigned by later writers—his insulting sarcasms, the embezzlement of money entrusted to him by Croesus for distribution at Delphi (Schol Ar. Vesp. 1446), the theft of a silver cup.



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AESOP, SITTING IN THE DOORWAY, RECOUNTING ONE OF HIS FAMOUS TALES

Reproduced after the woodcut in "Aesopi vita latine cum versione italica," etc., printed in Venice, March 27, 1492

Aesop must have been freed by Iadmon, or he could not have conducted the public defense of a Samian demagogue (Aristotle, *Rhetoric,* ii. 20). Legend says that he afterwards lived at the court of Croesus, where he met Solon, and dined in the company of the Seven Sages of Greece with Periander at Corinth. But it is impossible to say whether there is any grain of fact in this confused chronology. During the reign of Peisistratus he is said to have visited Athens, on which occasion he related the fable of *The Frogs asking for a King,* to dissuade the citizens from changing Peisistratus for another ruler.

The current stories about him are derived from a life, or rather romance, prefixed to a book of fables, purporting to be his, collected by Maximus Planudes, a monk of the 14th century. This describes him as ugly and deformed, as he is represented in the marble figure in the Villa Albani at Rome. That this life, however, was in existence a century before Planudes, appears from a 13th-century ms. of it found at Florence. In Plutarch's *Symposium of the Seven Sages,* at which Aesop is a guest, there are [illegible] original servile condition, but nothing derogatory is said about his personal appearance. We are further told that the Athenians set up a noble statue of him by Lysippus, which furnishes a strong argument against the fiction of his deformity. The obscurity in which the history of Aesop is involved has induced some scholars to deny his existence altogether

It is probable that Aesop did not commit his fables to writing (*Wasps,* 1259; Plato, *Phaedo,* 61 b). Demetrius of Phalerum (345–283 B.C.) made a collection in ten books, probably in prose, which has been lost Next appeared an edition in elegiac verse, cited by Suidas, but the author's name is unknown. Babrius, a Roman, turned the fables into choliambics in the earlier part of the 3rd century A.D. The most celebrated of the Latin adapters is Phaedrus, a freedman of Augustus. Avianus (of uncertain date, perhaps the 4th century) translated 42 fables into Latin elegaics. The collections, which we possess under the name of *Aesop's Fables,* are late renderings of Babrius's version, or Babrius was translated into Syriac, and back again into Greek. Ignatius Diaconus, in the 9th century, made a version of 53 fables in choliambic tetrameters. Stories from Oriental sources were added, and from these collections Maximus Planudes made and edited the collection which has come down to us under the name of Aesop, and from which the popular fables of modern Europe have been derived.

BIBLIOGRAPHY.—For further information *see* the article FABLE; Bentley, *Dissertation on the Fables of Aesop;* Du Méril, *Poésies inédites du moyen âge* (1854); J. Jacobs, *The Fables of Aesop* (1889); I. The history of the Aesopic fable; ii. The Fables of Aesop, as first printed by William Caxton (1484), from his French translation; Hervieux, *Les Fabulistes Latins* (1893–99). Before any Greek text appeared, a Latin translation of 100 *Fabulae Aesopicae* by an Italian scholar named Ranuzio (Renutius) was [illegible] Rome, 1476. About 1480 the collection of Planudes [illegible] at Milan by Buono Accorso (Accursius), together with Ranuzio's translation. This edition, which contained 144 fables, was frequently reprinted and additions were made from time to time from various mss—the Heidelberg (Palatine), Florentine, Vatican and Augsburg—by Stephanus (1547), Nevelet (1610), Hudson (1718), Wagenaar (1741), Furia (1810), Coray (1810), Schneider (1812) and others. A critical edition of all the previously known fables, prepared by Carl von Halm from the collations of Furia, Coray and Schneider, was published in the Teubner series of Greek and Latin texts. A *Fabularum Aesopicarum sylloge* (233 in number) from a Paris ms., with critical notes by Sternbach, appeared in a Cracow university publication, *Rozprawy akademii umiejetnosci* (1894).

**AESOPUS,** a Greek historian who wrote a history of Alexander the Great, a Latin translation of which, by Julius Valerius, was discovered by Mai in 1816. He is known as the pseudo-Callisthenes.

(*See* the references *s.v.* CALLISTHENES)

**AESOPUS, CLODIUS,** Roman tragedian, flourished in the first century B.C.

Cicero was on friendly terms with him. Aesopus made a last appearance in 55 B.C.—when Cicero tells us that he was advanced in years—on the occasion of the splendid games given by Pompey at the dedication of his theatre.

Horace (*Sat.* iii. 3. 239) mentions his taking a pearl from the ear-drop of Caecilia Metella and dissolving it in vinegar, that he might have the satisfaction of swallowing eight thousand pounds' worth at a draught.

BIBLIOGRAPHY—Cicero, *De Divinatione,* i. 37; *pro Sestio,* 56, 58; Quint., *Instit.* xi. 3, III.; Macrobius, *Sat.* iii. 14.

**AESTHETICS.** If we examine a poem in order to determine what it is that makes us feel it to be a poem, we at once find two constant and necessary elements: a complex of *images,* and a *feeling* that animates them. Let us, for instance, recall a passage learnt at school: Virgil's lines (*Aeneid,* iii., 294, *sqq.*), in which Aeneas describes how on hearing that in the country to whose shores he had come the Trojan Helenus was reigning, with Andromache, now his wife, he was overcome with amazement

and a great desire to see this surviving son of Priam and to hear of his strange adventures. Andromache, whom he meets outside the walls of the city, by the waters of a river renamed Simois, celebrating funeral rites before a cenotaph of green turf and two altars to Hector and Astyanax; her astonishment on seeing him, her hesitation, the halting words in which she questions him, uncertain whether he is a man or a ghost; Aeneas's no less agitated replies and interrogations, and the pain and confusion with which she recalls the past—how she lived through scenes of blood and shame, how she was assigned by lot as slave and concubine to Pyrrhus, abandoned by him and united to Helenus, another of his slaves, how Pyrrhus fell by the hand of Orestes and Helenus became a free man and a king; the entry of Aeneas and his men into the city, and their reception by the son of Priam in this little Troy, this mimic Pergamon with its new Xanthus, and its Scaean Gate whose threshold Aeneas greets with a kiss—all these details, and others here omitted, are images of persons, things, attitudes, gestures, sayings, joy and sorrow; mere images, not history or historical criticism, for which they are neither given nor taken. But through them all there runs a feeling, a feeling which is our own no less than the poet's, a human feeling of bitter memories, of shuddering horror, of melancholy, of homesickness, of tenderness, of a kind of childish *pietas* that could prompt this vain revival of things perished, these playthings fashioned by a religious devotion, the *parva Troia,* the *Pergama simulata magnis,* the *arentem Xanthi cognomine rivum:* something inexpressible in logical terms, which only poetry can express in full. Moreover, these two elements may appear as two in a first abstract analysis, but they cannot be regarded as two distinct threads, however intertwined; for, in effect, the feeling is altogether converted into images, into this complex of images, and is thus a feeling that is contemplated and therefore resolved and transcended. Hence poetry must be called neither feeling, nor image, nor yet the sum of the two, but "contemplation of feeling" or "lyrical intuition" or (which is the same thing) "pure intuition"—pure, that is, of all historical and critical reference to the reality or unreality of the images of which it is woven, and apprehending the pure throb of life in its ideality. Doubtless, other things may be found in poetry besides these two elements or moments and the synthesis of the two; but these other things are either present as extraneous elements in a compound (reflections, exhortations, polemics, allegories, etc.), or else they are just these image-feelings themselves taken in abstraction from their context as so much material, restored to the condition in which it was before the act of poetic creation. In the former case, they are non-poetic elements merely interpolated into or attached to the poem; in the latter, they are divested of poetry, rendered unpoetical by a reader either unpoetical or not at the moment poetical, who has dispelled the poetry, either because he cannot live in its ideal realm, or for the legitimate ends of historical enquiry or other practical purposes which involve the degradation —or rather, the conversion—of the poem into a document or an instrument.

**Artistic Qualities.**—What has been said of "poetry" applies to all the other "arts" commonly enumerated; painting, sculpture, architecture, music. Whenever the artistic quality of any product of the mind is discussed, the dilemma must be faced, that either it is a lyrical intuition, or it is something else, something just as respectable, but not art. If painting (as some theorists have maintained) were the imitation or reproduction of a given object, it would be, not art, but something mechanical and practical; if the task of the painter (as other theorists have held) were to combine lines and lights and colours with ingenious novelty of invention and effect, he would be, not an artist, but an inventor; if music consisted in similar combinations of notes, the paradox of Leibniz and Father Kircher would come true, and a man could write music without being a musician; or alternatively we should have to fear (as Proudhon did for poetry and John Stuart Mill for music) that the possible combinations of words or notes would one day be exhausted, and poetry or music would disappear. As in poetry, so in these other arts, it is notorious that foreign elements sometimes intrude themselves; foreign either *a parte objecti* or *a parte subjecti,* foreign either in fact or from the point of view of an inartistic spectator or listener. Thus the critics of these arts advise the artist to exclude, or at least not to rely upon, what they call the "literary" elements in painting, sculpture and music, just as the critic of poetry advises the writer to look for "poetry" and not be led astray by mere literature. The reader who understands poetry goes straight to this poetic heart and feels its beat upon his own; where this beat is silent, he denies that poetry is present, whatever and however many other things may take its place, united in the work, and however valuable they may be for skill and wisdom, nobility of intellect, quickness of wit and pleasantness of effect. The reader who does not understand poetry loses his way in pursuit of these other things He is wrong not because he admires them, but because he thinks he is admiring poetry.

**Other Forms of Activity As Distinct from Art.**—By defining art as lyrical or pure intuition we have implicitly distinguished it from all other forms of mental production If such distinctions are made explicit, we obtain the following negations.

1 *Art is not philosophy,* because philosophy is the logical thinking of the universal categories of being, and art is the unreflective intuition of being. Hence, while philosophy transcends the image and uses it for its own purposes, art lives in it as in a kingdom. It is said that art cannot behave in an irrational manner and cannot ignore logic; and certainly it is neither irrational nor illogical; but its own rationality, its own logic, is a quite different thing from the dialectical logic of the concept, and it was in order to indicate this peculiar and unique character that the name "logic of sense" or "aesthetic" was invented The not uncommon assertion that art has a logical character, involves either an equivocation between conceptual logic and aesthetic logic, or a symbolic expression of the latter in terms of the former.

2. *Art is not history,* because history implies the critical distinction between reality and unreality; the reality of the fact and the reality of a fancied world: the reality of action and the reality of desire. For art, these distinctions are as yet unmade; it lives, as we have said, upon pure images. The historical existence of Helenus, Andromache and Aeneas makes no difference to the poetical quality of Virgil's poem. Here, too, an objection has been raised: namely that art is not wholly indifferent to historical criteria, because it obeys the laws of "verisimilitude"; but, here again, "verisimilitude" is only a rather clumsy metaphor for the mutual coherence of images, which without this internal coherence would fail to produce their effect as images, like Horace's *delphinus in silvis* and *aper in fluctibus.*

3. *Art is not natural science,* because natural science is historical fact classified and so made abstract; nor is it *mathematical science,* because mathematics performs operations with abstractions and does not contemplate. The analogy sometimes drawn between mathematical and poetical creation is based on merely external and generic resemblances; and the alleged necessity of a mathematical or geometrical basis for the arts is only another metaphor, a symbolic expression of the constructive, cohesive and unifying force of the poetic mind building itself a body of images.

4. *Art is not the play of fancy,* because the play of fancy passes from image to image, in search of variety, rest or diversion, seeking to amuse itself with the likenesses of things that give pleasure or have an emotional and pathetic interest; whereas in art the fancy is so dominated by the single problem of converting chaotic feeling into clear intuition, that we recognize the propriety of ceasing to call it fancy and calling it imagination, poetic imagination or creative imagination. Fancy as such is as far removed from poetry as are the works of Mrs. Radcliffe or Dumas *père.*

5. *Art Is Not Feeling in Its Immediacy.*—Andromache, on seeing Aeneas, becomes *amens, diriguit visu in medio, labitur, longo vix tempore fatur,* and when she speaks *longos ciebat incassum fletus;* but the poet does not lose his wits or grow stiff as he gazes; he does not totter or weep or cry; he expresses himself in harmonious verses, having made these various perturbations the object of which he sings. Feelings in their immediacy are "expressed"

for if they were not, if they were not also sensible and bodily facts ("psycho-physical phenomena," as the positivists used to call them) they would not be concrete things, and so they would be nothing at all. Andromache expressed herself in the way described above. But "expression" in this sense, even when accompanied by consciousness, is a mere metaphor from "mental" or "aesthetic expression" which alone really expresses, that is, gives to feeling a theoretical form and converts it into words, song and outward shape. This distinction between contemplated feeling, or poetry, and feeling enacted or endured, is the source of the power, ascribed to art, of "liberating us from the passions" and "calming" us (the power of *catharsis*), and of the consequent condemnation, from an aesthetic point of view, of works of art, or parts of them, in which immediate feeling has a place or finds a vent. Hence, too, arises another characteristic of poetic expression—really synonymous with the last—namely its "infinity" as opposed to the "finitude" of immediate feeling or passion; or, as it is also called, the "universal" or "cosmic" character of poetry. Feeling, not crushed but contemplated by the work of poetry, is seen to diffuse itself in widening circles over all the realm of the soul, which is the realm of the universe, echoing and re-echoing endlessly: joy and sorrow, pleasure and pain, energy and lassitude, earnestness and frivolity, and so forth, are linked to each other and lead to each other through infinite shades and gradations; so that the feeling, while preserving its individual physiognomy and its original dominating motive, is not exhausted by or restricted to this original character. A comic image, if it is poetically comic, carries with it something that is not comic, as in the case of Don Quixote or Falstaff; and the image of something terrible is never, in poetry, without an atoning element of loftiness, goodness and love.

6. *Art is not instruction or oratory:* it is not circumscribed and limited by service to any practical purpose whatever, whether this be the inculcation of a particular philosophical, historical or scientific truth, or the advocacy of a particular way of feeling and the action corresponding to it Oratory at once robs expression of its "infinity" and independence, and, by making it the means to an end, dissolves it in this end. Hence arises what Schiller called the "non-determining" character of art, as opposed to the "determining" character of oratory; and hence the justifiable suspicion of "political poetry"—political poetry being, proverbially, bad poetry.

7. As art is not to be confused with the form of practical action most akin to it, namely instruction and oratory, so *a fortiori,* it must not be confused with other forms directed to the production of certain effects, whether these consist in pleasure, enjoyment and utility, or in goodness and righteousness. We must exclude from art not only meretricious works, but also those inspired by a desire for goodness, as equally, though differently, inartistic and repugnant to lovers of poetry. Flaubert's remark that indecent books lacked *vérité,* is parallel to Voltaire's gibe that certain "poésies sacrées" were really "sacrées, car personne n'y touche."

**Art in Its Relations.**—The "negations" here made explicit are obviously, from another point of view, "relations"; for the various distinct forms of mental activity cannot be conceived as separate each from the rest and acting in self-supporting isolation. This is not the place to set forth a complete system of the forms or categories of the mind in their order and their dialectic; confining ourselves to art, we must be content to say that the category of art, like every other category, mutually presupposes and is presupposed by all the rest: it is conditioned by them all and conditions them all. How could the aesthetic synthesis, which is poetry, arise, were it not preceded by a state of mental commotion? *Si vis me flere, dolendum est,* and so forth. And what is this state of mind which we have called feeling, but the whole mind, with its past thoughts, volitions and actions, now thinking and desiring and suffering and rejoicing, travailing within itself? Poetry is like a ray of sunlight shining upon this darkness, lending it its own light and making visible the hidden forms of things. Hence it cannot be produced by an empty and dull mind; hence those artists who embrace the creed of pure art or art for art's sake, and close their hearts to the troubles of life and the cares of thought, are found to be wholly unproductive, or at most rise to the imitation of others or to an impressionism devoid of concentration Hence the basis of all poetry is human personality, and, since human personality finds its completion in morality, the basis of all poetry is the moral consciousness. Of course this does not mean that the artist must be a profound thinker or an acute critic; nor that he must be a pattern of virtue or a hero; but he must have a share in the world of thought and action which will enable him, either in his own persón or by sympathy with others, to live the whole drama of human life. He may sin, lose the purity of his heart, and expose himself, as a practical agent, to blame; but he must have a keen sense of purity and impurity, righteousness and sin, good and evil. He may not be endowed with great practical courage; he may even betray signs of timidity and cowardice; but he must feel the dignity of courage. Many artistic inspirations are due, not to what the artist, as a man, is in practice, but to what he is not, and feels that he ought to be admiring and enjoying the qualities he lacks when he sees them in others. Many, perhaps the finest, pages of heroic and warlike poetry are by men who never had the nerve or the skill to handle a weapon. On the other hand, we are not maintaining that the possession of a moral personality is enough to make a poet or an artist. To be a *vir bonus* does not make a man even an orator, unless he is also *dicendi peritus* The *sine qua non* of poetry is poetry, that form of [illegible] synthesis which we have defined above; the spark of poetical genius without which all the rest is mere fuel, not burning because no fire is at hand to light it. But the figure of the pure poet, the pure artist, the votary of pure Beauty, aloof from contact with humanity, is no real figure but a caricature.

That poetry not only presupposes the other forms of human mental activity but is presupposed by them, is proved by the fact that without the poetic imagination which gives contemplative form to the workings of feeling, intuitive expression to obscure impressions and thus becomes representations and words, whether spoken or sung or painted or otherwise uttered, logical thought could not arise. Logical thought is not language, but it never exists without language, and it uses the language which poetry has created; by means of concepts, it discerns and dominates the representations of poetry, and it could not dominate them unless they, its future subjects, had first an existence of their own. Further, without the discerning and criticizing activity of thought, action would be impossible; and if action, then good action, the moral consciousness, duty. Every man, however much he may seem to be all logical thinker, critic, scientist, or all absorbed in practical interests or devoted to duty, cherishes at the bottom of his heart his own private store of imagination and poetry; even Faust's pedantic *famulus,* Wagner, confessed that he often had his "grillenhafte Stunden." Had this element been altogether denied him, he would not have been a man, and therefore not even a thinking or acting being. This extreme case is an absurdity; but in proportion as this private store is scanty, we find a certain superficiality and aridity in thought, and a certain coldness in action.

**The Science of Art, or Aesthetics, and Its Philosophical Character.**—The concept of art expounded above is in a sense the ordinary concept, which appears with greater or less clarity in all statements about art, and is constantly appealed to, explicitly or implicitly, as the fixed point round which all discussions on the subject gravitate: and this, not only nowadays, but at all times, as could be shown by the collection and interpretation of things said by writers, poets, artists, laymen and even the common people. But it is desirable to dispel the illusion that this concept exists as an innate idea, and to replace this by the truth, that it operates as an *a priori* concept. Now an *a priori* concept does not exist by itself, but only in the individual products which it generates. Just as the *a priori* reality called Art, Poetry or Beauty does not exist in a transcendent region where it can be perceived and admired in itself, but only in the innumerable works of poetry, of art and of beauty which it has formed and continues to form, so the logical *a priori* concept of art exists nowhere but in the par-

ticular judgments which it has formed and continues to form, the refutations which it has effected and continues to effect, the demonstrations it makes, the theories it constructs, the problems and groups of problems, which it solves and has solved. The definitions and distinctions and negations and relations expounded above have each its own history, and have been progressively worked out in the course of centuries, and in them we now possess the fruits of this complex and unremitting toil. Aesthetic, or the science of art, has not therefore the task (attributed to it by certain scholastic conceptions) of defining art once for all and deducing from this conception its various doctrines, so as to cover the whole field of aesthetic science; it is only the perpetual systematization, always renewed and always growing, of the problems arising from time to time out of reflection upon art, and is identical with the solutions of the difficulties and the criticisms of the errors which act as stimulus and material to the unceasing progress of thought. This being so, no exposition of aesthetic (especially a summary exposition such as can alone be given here) can claim to deal exhaustively with the innumerable problems which have arisen and may arise in the course of the history of aesthetics; it can only mention and discuss the chief, and among these, by preference, those which still make themselves felt and resist solution in ordinary educated thought; adding an implied "et cetera," so that the reader may pursue the subject according to the criteria set before him, either by going again over old discussions, or by entering into those of to-day, which change and multiply and assume new shapes almost daily. Another warning must not be omitted. namely that aesthetics, though a special philosophical science, having as its principle a special and distinct category of the mind, can never, just because it is philosophical, be detached from the main body of philosophy; for its problems are concerned with the relations between art and the other mental forms, and therefore imply both difference and identity. Aesthetics is really the whole of philosophy, but with special emphasis on that side of it which concerns art Many have demanded or imagined or desired a self-contained aesthetics, devoid of any general philosophical implications, and consistent with more than one, or with any, philosophy; but the project is impossible of execution because self-contradictory. Even those who promise to expound a naturalistic, inductive, physical, physiological or psychological aesthetics—in a word, a non-philosophical aesthetics —when they pass from promise to performance surreptitiously introduce a general positivistic, naturalistic or even materialistic philosophy. And anyone who thinks that the philosophical ideas of positivism, naturalism and materialism are false and out of date, will find it an easy matter to refute the aesthetic or pseudo-aesthetic doctrines which mutually support them and are supported by them, and will not regard their problems as problems still awaiting solution or worthy of discussion—or, at least, protracted discussion. For instance, the downfall of psychological associationism (or the substitution of mechanism for *a priori* synthesis) implies the downfall not only of logical associationism but of aesthetics also, with its association of "content" and "form," or of two "representations," which (unlike Campanella's *tactus intrinsecus,* effected *cum magna suavitate*) was a *contactus extrinsecus* whose terms were no sooner united than they *discedebant.* The collapse of biological and evolutionary explanations of logical and ethical values implies the same collapse in the case of aesthetic value. The proved inability of empirical methods to yield knowledge of reality, which in fact they can only classify and reduce to types, involves the impossibility of an aesthetics arrived at by collecting aesthetic facts in classes and discovering their laws by induction.

**Intuition and Expression.**—One of the first problems to arise, when the work of art is defined as "lyrical image," concerns the relation of "intuition" to "expression" and the manner of the transition from the one to the other. At bottom this is the same problem which arises in other parts of philosophy: the problem of inner and outer, of mind and matter, of soul and body, and, in ethics, of intention and will, will and action, and so forth Thus stated, the problem is insoluble; for once we have divided the inner from the outer, body from mind, will from action, or intuition from expression, there is no way of passing from one to the other or of reuniting them, unless we appeal for their reunion to a third term, variously represented as God or the Unknowable. Dualism leads necessarily either to transcendence or to agnosticism But when a problem is found to be insoluble in the terms in which it is stated the only course open is to criticize these terms themselves, to inquire how they have been arrived at, and whether their genesis was logically sound In this case, such inquiry leads to the conclusion that the terms depend not upon a philosophical principle, but upon an empirical and naturalistic classification, which has created two groups of facts called internal and external respectively (as if internal facts were not also external, and as if an external fact could exist without being also internal), or souls and bodies, or images and expressions; and everyone knows that it is hopeless to try to find a dialectical unity between terms that have been distinguished not philosophically or formally but only empirically and materially. The soul is only a soul in so far as it is a body, the will is only a will in so far as it moves arms and legs, or is action; intuition is only intuition in so far as it is, in that very act, expression An image that does not express, that is not speech, song, drawing painting, sculpture or architecture—speech at least murmured to oneself, song at least echoing within one's own breast, line and colour seen in imagination and colouring with its own tint the whole soul and organism—is an image that does not exist. We may assert its existence, but we cannot support our assertion; for the only thing we could adduce in support of it would be the fact that the image was embodied or expressed This profound philosophical doctrine, the *identity of intuition and expression* is, moreover, a principle of ordinary common sense, which laughs at people who claim to have thoughts they cannot express or to have imagined a great picture which they cannot paint. *Rem tene, verba sequentur;* if there are no *verba,* there is no *res* This identity, which applies to every sphere of the mind, has in the sphere of art a clearness and self-evidence lacking, perhaps, elsewhere In the creation of a work of poetry, we are present, as it were, at the mystery of the creation of the world; hence the value of the contribution made by aesthetics to philosophy as a whole, or the conception of the One that is All. Aesthetics, by denying in the life of art an abstract spiritualism and the resulting dualism, prepares the way and leads the mind towards idealism or absolute spiritualism.

**Expression and Communication.**—Objections to the identity of intuition and expression generally arise from psychological illusions which lead us to believe that we possess at any given moment a profusion of concrete and lively images, when in fact we only possess signs and names for them; or else from faulty analysis of cases like that of the artist who is believed to express mere fragments of a world of images that exists in his mind in its entirety, whereas he really has in his mind only these fragments, together with—not the supposed complete world, but at most an aspiration or obscure working towards it, towards a greater and richer image which may take shape or may not. But these objections also arise from a confusion between *expression* and *communication,* the latter being really distinct from the image and its expression. Communication is the fixation of the intuition-expression upon an object metaphorically called material or physical; in reality, even here we are concerned not with material or physical things but with a mental process The proof that the so-called physical object is unreal, and its resolution into terms of mind, is primarily of interest for our general philosophical conceptions, and only indirectly for the elucidation of aesthetic questions; hence for brevity's sake we may let the metaphor or symbol stand and speak of matter or nature It is clear that the poem is complete as soon as the poet has expressed it in words which he repeats to himself. When he comes to repeat them aloud, for others to hear, or looks for someone to learn them by heart and repeat them to others as in a *schola cantorum,* or sets them down in writing or in printing, he has entered upon a new stage, not aesthetic but practical, whose social and cultural importance need not, of course, be insisted upon. So with the painter; he paints on his panel or canvas, but

he could not paint unless at every stage in his work, from the original blur or sketch to the finishing touches, the intuited image, the line and colour painted in his imagination, preceded the brush-stroke. Indeed, when the brush-stroke outruns the image, it is cancelled and replaced by the artist's correction of his own work. The exact line that divides expression from communication is difficult to draw in the concrete case, for in the concrete case the two processes generally alternate rapidly and appear to mingle, but it is clear in idea, and it must be firmly grasped Through overlooking it, or blurring it through insufficient attention, arise the confusions between *art* and *technique*. Technique is not an intrinsic element of art but has to do precisely with the concept of communication. In general it is a cognition or complex of cognitions disposed and directed to the furtherance of practical action, and, in the case of art, of the practical action which makes objects and instruments for the recording and communicating of works of art; *e g*, cognitions concerning the preparation of panels, canvases or walls to be painted, pigments, varnishes, ways of obtaining good pronunciation and declamation and so forth. Technical treatises are not aesthetic treatises, nor yet parts or chapters of them. Provided, that is, that the ideas are rigorously conceived and the words used accurately in relation to them it would not be worth while to pick a quarrel over the use of the word "technique" as a synonym for the artistic work itself, regarded as "inner technique" or the formation of intuition-expressions. The confusion between art and technique is especially beloved by impotent artists, who hope to obtain from practical things and practical devices and inventions the help which their strength does not enable them to give themselves.

**Artistic Objects: the Theory of the Special Arts, and the Beauty of Nature.**—The work of communicating and conserving artistic images, with the help of technique, produces the material objects metaphorically called *"artistic objects"* or *"works of art":* pictures, sculptures and buildings, and, in a more complicated manner, literary and musical writings, and, in our own times, gramophones and records which make it possible to reproduce voices and sounds. But neither these voices and sounds nor the symbols of writing, sculpture and architecture, are works of art; works of art exist only in the minds that create or recreate them. To remove the appearance of paradox from the truth that beautiful objects, beautiful things, do not exist, it may be opportune to recall the analogous case of economic science, which knows perfectly well that in the sphere of economics there are no naturally or physically *useful* things, but only demand and labour, from which physical things acquire, metaphorically, this epithet. A student of economics who wished to deduce the economic value of things from their physical qualities would be perpetrating a gross *ignoratio elenchi.*

Yet this same *ignoratio elenchi* has been, and still is, committed in aesthetic, by the theory of special *arts,* and the limits or peculiar aesthetic character of each The divisions between the arts are merely technical or physical, according as the artistic objects consist of physical sounds, notes, coloured objects, carved or modelled objects, or constructed objects having no apparent correspondence with natural bodies (poetry, music, painting, sculpture, architecture, etc.). To ask what is the artistic character of each of these arts, what it can and cannot do, what kinds of images can be expressed in sounds, what in notes, what in colours, what in lines, and so forth, is like asking in economics what things are entitled by their physical qualities to have a value and what are not, and what relative values they are entitled to have; whereas it is clear that physical qualities do not enter into the question, and anything may be desired or demanded or valued more than another, or more than anything else at all, according to circumstances and needs Even Lessing found himself slipping down the slope leading to this truth, and was forced to such strange conclusions as that actions belonged to poetry and bodies to sculpture; even Richard Wagner attempted to find a place in the list for a comprehensive art, namely Opera, including in itself by a process of aggregation the powers of all the arts. A reader with any artistic sense finds in a single solitary line from a poet at once musical and picturesque qualities, sculpturesque strength and architectural structure, and the same with a picture, which is never a mere thing of the eyes but an affair of the whole soul, and exists in the soul not only as colour but as sound and speech. But when we try to grasp these musical or picturesque or other qualities, they elude us and turn into each other, and melt into a unity, however we may be accustomed to distinguish them by different names; a practical proof that art is one and cannot be divided into arts. One, and infinitely varied; not according to the technical conceptions of the several arts, but according to the infinite variety of artistic personalities and their states of mind.

With this relation (and confusion) between artistic creations and instruments of communication or *objets d'art* must be connected the problem of *natural beauty.* We shall not discuss the question, raised by certain aestheticians, whether there are in nature other poets, other artistic beings, beside man; a question which ought to be answered in the affirmative not only out of respect for the song-birds, but, still more, out of respect for the idealistic conception of the world as life and spirituality throughout, even if (as the fairy-tale goes) we have lost the magic herb which when we put it in our mouth, gives us the power of understanding the language of animals and plants The phrase *natural beauty* properly refers to persons, things and places whose effect is comparable to that of poetry, painting, sculpture and the other arts There is no difficulty in allowing the existence of such "natural *objets d'art,*" for the process of poetic communication may take place by means of objects naturally given as well as by means of objects artificially produced. The lover's imagination creates a woman beautiful to him, and personifies her in Laura; the pilgrim's imagination creates the charming or sublime landscape, and embodies it in the scene of a lake or a mountain; and these creations of theirs are sometimes shared by more or less wide social circles, thus becoming the "professional beauties" admired by everyone and the famous "views" before which all experience a more or less sincere rapture. No doubt, these creations are mortal; ridicule sometimes kills them, satiety may bring neglect, fashion may replace them by others; and—unlike works of art—they do not admit of authentic interpretation. The bay of Naples, seen from the height of one of the most beautiful Neapolitan villas, was after some time described by the Russian lady who owned the villa as *une cuvette bleue,* whose blue encircled by green so wearied her that she sold the villa. But even the *cuvette bleue* was a legitimate poetical creation.

**Literary Kinds and Aesthetic Categories.**—Effects at once greater and more detrimental upon the criticism and historical study of art and literature have been produced by a theory of similar but slightly different origin, the theory of *literary and artistic kinds.* This, like the foregoing, is based on a classification in itself justifiable and useful. The foregoing is based on a technical or physical classification of artistic objects; this is based on a classification according to the feelings which form their content or motive, into *tragic, comic, lyrical, heroic, erotic, idyllic, romantic* and so on, with divisions and subdivisions. It is useful in practice to distribute an artist's works, for purposes of publication, into these classes, putting lyrics in one volume, dramas in another, poems in a third and romances in a fourth; and it is convenient, in fact, indispensable, to refer to works and groups of works by these names in speaking and writing of them. But here again we must deny and pronounce illegitimate the transition from these classificatory concepts to the poetic laws of composition and aesthetic criteria of judgment, as when people try to decide that a tragedy must have a subject of a certain kind, characters of a certain kind, a plot of a certain kind and a certain length; and, when confronted by a work, instead of looking for and appraising its own poetry, ask whether it is a tragedy or a poem, and whether it obeys the "laws" of one or other "kind." The literary criticism of the 19th century owed its great progress largely to its abandonment of the criteria of kinds, in which the criticism of the Renaissance and the French classicists had always been entangled, as may be seen from the discussions arising out of the poems of Dante, Ariosto and Tasso, Guarini's *Pastor fido,* Corneille's *Cid,* and Lope de Vega's *comedias.* Artists have profited by this liberation less than critics; for anyone with

artistic genius bursts the fetters of such servitude, or even makes them the instruments of his power; and the artist with little or no genius turns his very freedom into a new slavery

It has been thought that the divisions of kinds could be saved by giving them a philosophical significance; or at any rate one such division, that of lyric, epic and dramatic, regarded as the three moments of a process of objectification passing from the lyric, the outpouring of the ego, to the epic, in which the ego detaches its [illegible] itself by narrating it, and thence to the drama, in which it allows this feeling to create of itself its own mouthpieces, the *dramatis personae*. But the lyric is not a pouring-forth; it is not a cry or a lament; it is an objectification in which the ego sees itself on the stage, narrates itself, and dramatizes itself; and this lyrical spirit forms the poetry both of epic and of drama, which are therefore distinguished from the lyric only by external signs A work which is altogether poetry, like *Macbeth* or *Antony and Cleopatra*, is substantially a lyric in which the various tones and successive verses are represented by characters and scenes.

In the old aesthetics, and even to-day in those which perpetuate the type, an important place is given to the so-called categories of beauty: the *sublime*, the *tragic*, the *comic*, the *graceful*, the *humorous* and so forth, which German philosophers not only claimed to treat as philosophical concepts, whereas they are really mere psychological and empirical concepts, but developed by means of that dialectic which belongs only to pure or speculative concepts, philosophical categories. Thus they arranged them in an imaginary progress culminating now in the Beautiful, now in the Tragic, now in the Humorous Taking these concepts at their face value, we may observe their substantial correspondence with the concepts of the literary and artistic kinds; and this is the source from which, as excerpts from manuals of literature, they have found their way into philosophy As psychological and empirical concepts, they do not belong to aesthetics; and as a whole, in their common quality, they refer merely to the world of feelings, empirically grouped and classified, which forms the permanent matter of artistic intuition.

**Rhetoric, Grammar and Philosophy of Language.**—Every error has in it an element of truth, and arises from an arbitrary combination of things which in themselves are legitimate. This principle may be confirmed by an examination of other erroneous doctrines which have been prominent in the past and are still to a less degree prominent to-day. It is perfectly legitimate, in teaching people to write, to make use of distinctions like that between simple style, ornate style and metaphorical style and its forms, and to point out that here the pupil ought to express himself literally and there metaphorically, or that here the metaphor used is incoherent or drawn out to excessive length, and that here the figure of "preterition," there "hypotyposis" or "irony," would have been suitable. But when people lose sight of the merely practical and didactic origin of these distinctions and construct a philosophical theory of form as divisible into simple form and ornate form, logical form and affective form, and so forth, they are introducing elements of rhetoric into aesthetics and vitiating the true concept of expression. For expression is never logical, but always affective, that is lyrical and imaginative; and hence it is never metaphorical but always "proper"; it is never simple in the sense of lacking elaboration, or ornate in the sense of being loaded with extraneous elements; it is always adorned with itself, *simplex munditiis*. Even logical thought or science, so far as it is expressed, becomes feeling and imagination, which is why a philosophical or historical or scientific book can be not only true but beautiful, and must always be judged not only logically but also aesthetically. Thus we sometimes say that a book is a failure as theory, or criticism, or historical truth, but a success as a work of art, in view of the feeling animating it and expressed in it. As for the element of truth which is obscurely at work in this distinction between logical form and metaphorical form, dialectic and rhetoric, we may detect in it the need of a science of aesthetics side by side with that of logic; but it was a mistake to try to distinguish the two sciences within the sphere of expression which belongs to one of them alone.

Another element in education, namely the teaching of languages, has no less legitimately, ever since ancient times classified expressions into periods, propositions and words, and words into various species, and each species according to the variations and combinations of roots and suffixes, syllables and letters, and hence have arisen alphabets, grammars and vocabularies, just as in another way for poetry has arisen a science of prosody, and for music and the figurative and architectural arts there have arisen musical and pictorial grammars and so forth But here, too, the ancients did not succeed in avoiding an illegitimate transition *ab intellectu ad rem*, from abstractions to reality, from the empirical to the philosophical, such as we have already observed elsewhere; and this involved thinking of speech as an aggregation of words, and words as aggregations of syllables or of roots and suffixes; whereas the *prius* is speech itself, a continuum, resembling an organism, and words and syllables and roots are a *posterius*, an anatomical preparation, the product of the abstracting intellect, not the original or real fact. If grammar, like rhetoric in the case above considered, is transplanted into aesthetic, the result is a distinction between expression and the means of expression, which is a mere reduplication; for the means of expression are just expression itself, broken into pieces by grammarians This error, combined with the error of distinguishing between simple and ornate form, has prevented people from seeing that the philosophy of language is not a philosophic grammar, but is wholly devoid of grammatical elements It does not raise grammatical classifications to a philosophical level: it ignores them, and, when they get in its way, destroys them The philosophy of language, in a word, is identical with the philosophy of poetry and art, the science of intuition-expression, aesthetics, which embraces language in its whole extension, passing beyond the limits of phonetic and syllabic language, and in its unimpaired reality as living and completely significant expression

**Classical and Romantic.**—The problems reviewed above belong to the past—a past extending through centuries—rather than to the present; of their mis-stated questions and misconceived solutions there now remain mere relics and superstitions which affect academic treatises more than they do the consciousness and culture of ordinary people. But it is necessary to watch carefully for new shoots from the old stock, which still appear from time to time, in order to cut them down Such is, in our own time, the theory of styles applied to the history of art (Wolfflin and others) and extended to the history of poetry (Strick and others), a new irruption of rhetorical abstractions into the judgment and history of works of art. But the chief problem of our time, to be overcome by aesthetics, is connected with the crisis in art and in judgments upon art produced by the romantic period Not that this crisis was not foreshadowed by precedents and parallels in earlier history, like Alexandrian art and that of the late Roman period, and in modern times the Baroque art and poetry which followed upon that of the Renaissance The crisis of the romantic period, together with sources and characteristics peculiar to itself, had a magnitude all of its own. It asserted an antithesis between *naïve* and *sentimental* poetry, *classical* and *romantic* art, and thus denied the unity of art and asserted a duality of two fundamentally different arts, of which it took the side of the second, as that appropriate to the modern age, by upholding the primary importance in art of feeling, passion and fancy. In part this was a justifiable reaction against the rationalistic literature of classicism in the French manner, now satirical, now frivolous, weak in feeling and imagination and deficient in a deep poetic sense; but in part, *romanticism* was a rebellion not against *classicism* but against the classical as such: against the idea of the serenity and infinity of the artistic image, against catharsis and in favour of a turbid emotionalism that could not and would not undergo purification. This was very well understood by Goethe, the poet both of passion and of serenity, and therefore, because he was a poet, a classical poet; who opposed romantic poetry as "hospital poetry." Later, it was thought that the disease had run its course and that romanticism was a thing of the past; but though some of its contents and some of its forms were dead, its soul was not: its soul consisting in this tendency on the part of art towards

an immediate expression of passions and impressions Hence it changed its name but went on living and working. It called itself "realism," "verism," "symbolism," "artistic style," "impressionism," "sensualism," "imagism," "decadentism," and nowadays, in its extreme forms, "expressionism" and "futurism" The very conception of art is attacked by these doctrines, which tend to replace it by the conception of one or other kind of non-art; and the statement that they are fighting against art is confirmed by the hatred of the extremists of this movement for museums and libraries and all the art of the past—that is, for the idea of art which on the whole corresponds with art as it has been historically realized The connection of this movement, in its latest modern form, with industrialism and the psychology produced and fostered by industrialism is obvious What art is contrasted with is practical life as lived to-day; and art, for this movement, is not the expression of life and hence the transcending of life in the contemplation of the infinite and universal, but the cries and gesticulations and broken colours of life itself. The real poets and artists, on the other hand, rare at any time, naturally continue, nowadays as always, to work according to the old and only idea of what art is, expressing their feelings in harmonious forms; and the real connoisseurs (rarer, these also, than people think) continue to judge their work according to this same idea. In spite of this, the tendency to destroy the idea of art is a characteristic of our age; and this tendency is based on the *proton pseudos* which confuses mental or aesthetic expression with natural or practical expression—the expression which passes confusedly from sensation to sensation and is a mere effect of sensation, with the expression which art elaborates, as it builds, draws, colours or models, and which is its beautiful creation The problem for aesthetics to-day is the reassertion and defence of the classical as against romanticism: the synthetic, formal theoretical element which is the *proprium* of art, as against the affective element which it is the business of art to resolve into itself, but which to-day has turned against it and threatens to displace it. Against the inexhaustible fertility of creative mind, the gates of hell shall not prevail; but the hostility which endeavours to make them prevail is disturbing, even if only in an incidental manner, the artistic taste, the artistic life and consequently the intellectual and moral life of to-day.

**The Criticism and History of Art and Literature.**—Another group of questions raised in works on aesthetics, though not unsuitable to such works, properly belongs to logic and the theory of historical thought. These concern the aesthetic judgment and the history of poetry and the arts. By showing that the aesthetic activity (or art) is one of the forms of mind, a value, a category, or whatever we choose to call it, and not (as philosophers of various schools have thought) an empirical concept referable to certain orders of utilitarian or mixed facts, by establishing the *autonomy of aesthetic value,* aesthetics has also shown that it is the predicate of a special judgment, the *aesthetic judgment,* and the subject-matter of history, of a special history, the history of poetry and the arts, *artistic and literary history.*

The questions that have been raised concerning the aesthetic judgment and artistic and literary history are making allowance for the peculiar character of art, identical with the methodological questions that arise in every field of historical study. It has been asked whether the aesthetic judgment is *absolute* or *relative;* but every historical judgment (and the aesthetic judgment affirming the reality and quality of aesthetic facts is an historical judgment) is always both absolute and relative at once: absolute, in so far as the category involved in the construction possesses universal truth; relative, in so far as the object constructed by that category is historically conditioned: hence in the historical judgment the category is individualized and the individual becomes absolute. Those who in the past have denied the absoluteness of the aesthetic judgment (sensationalistic, hedonistic or utilitarian aestheticians) denied in effect the quality, reality and autonomy of art. It has been asked whether a knowledge of the history of the time—the whole history of the time in question—is necessary for the aesthetic judgment of the art of that time; it certainly is, because, as we know, poetic creation presupposes all the rest of the mind which it is converting into lyrical imagery, and the one aesthetic creation presupposes all the other creations (passions, feelings, customs, etc.) of the given historical moment. Hence may be seen the error both of those who advocate a merely historical judgment upon art (historical critics) and of those who advocate a merely aesthetic (aesthetic critics) The former would find in art all the rest of history (social conditions, biography of the artist, etc ), but would omit that part which is proper to art; the latter would judge the work of art in abstraction from history, depriving it of its real meaning and giving it an imaginary meaning or testing it by arbitrary standards. Lastly, there has appeared a kind of scepticism or pessimism as to the possibility of understanding the art of the past; a scepticism or pessimism which in that case ought to extend to every part of history (history of thought, politics, religion and morality), and refutes itself by a *reductio ad absurdum,* since what we call contemporary art and history really belong to the past as much as those of more distant ages, and must, like them, be re-created in the present, in the mind that feels them and the intellect that understands them. There are artistic works and periods that remain to us unintelligible; but this only means that we are not now in a position to enter again into their life and to understand them, and the same is true of the ideas and customs and actions of many peoples and ages. Humanity, like the individual, remembers some things and forgets many others; but it may yet, in the course of its mental development, reach a point where its memory of them revives.

A final question concerns the form proper to artistic and literary history, which, in the form that arose in the romantic period, and still prevails to-day, expounds the history of works of art as a function of the concepts and social needs of its various periods, regarding them as aesthetic expressions of these things and connecting them closely with civil history This tends to obscure and almost to render invisible the peculiar character of the individual work of art, the character which makes it impossible to confuse one work of art with any other, and results in treating them as documents of social life. In practice no doubt this method is tempered by what may be called the "individualizing" method, which emphasizes the individual character of the works; but the mixture has the defects of all eclecticism. To escape this, there is nothing to do but consistently to develop individualizing history, and to treat works of art not in relation to social history but as each a world in itself, into which from time to time the whole of history is concentrated, transfigured and imaginatively transcended in the individuality of the poetic work, which is a creation, not a reflection, a monument, not a document. Dante is not simply a document of the middle ages, nor Shakespeare of the English Renaissance; as such, they have many equals or superiors among bad poets and non-poets. It has been objected that this method imposed on artistic and literary history the form of a series of disconnected essays or monographs; but, obviously, the connection is provided by human history as a whole, of which the personalities of poets constitute a part, and a somewhat conspicuous part (Shakespearian poetry is an event no less important than the Reformation or the French Revolution), and, precisely because they are a part of it, they ought not to be submerged and lost in it, that is, in its other parts, but ought to retain their proper proportions and their original character

**History of Aesthetics.**—From the character of aesthetics as a philosophical science (*see* above) it follows that its history cannot be separated from that of philosophy at large, from which aesthetics receives light and guidance, and gives back light and guidance in its turn. The so-called subjectivist tendency which modern philosophy acquired with Descartes, for instance, by promoting enquiry into the creative power of the mind, indirectly promoted enquiry into the aesthetic power; and [illegible] an example of the influence of aesthetic on the rest [illegible], it is enough to recall the effect which the mature consciousness of creative imagination and poetic logic had in liberating philosophical logic from the traditional intellectualism and formalism, and raising it to the level of speculative or dialectical logic in

the philosophies of Schelling and Hegel. But if the history of aesthetics must be seen as a part of the entire history of philosophy, it must on the other hand be enlarged beyond its boundaries as ordinarily defined, which would restrict it almost entirely to the series of works by so-called professional philosophers and of the academic treatises known as "systems of philosophy." Genuine and original philosophical thought is often to be found, alive and energetic in books not written by professional philosophers and not outwardly systematic; ethical thought, in works of asceticism and religion; political, in the works of historians; aesthetic, in those of art-critics, and so forth. Further, it must be remembered that, strictly speaking, the subject-matter of the history of aesthetics is not the problem, the single problem, of the definition of art, a problem exhausted when that definition has been or shall have been attained; but the innumerable problems which are perpetually springing up in connection with art, in which this one problem, the problem of defining art, acquires particularity and concreteness, and in which alone it truly exists Subject to these warnings, which must be carefully borne in mind, a general sketch of the history of aesthetics may be given, to provide a preliminary orientation, without running the risk of being understood in an unduly rigid and simplificatory manner.

A sketch of this kind must accept, not merely as convenient for purposes of exposition but as historically true, the common statement that aesthetics is a modern science. Graeco-Roman antiquity did not speculate about art, or speculated very little; its chief concern was to create a method of artistic instruction, not a "philosophy" but an "empirical science" of art. Such are the ancient treatises on "grammar," "rhetoric," "institutions of oratory," "architecture," "music," "painting" and "sculpture"; the basis of all later methods of instruction, even those of to-day, in which the old principles are restated and interpreted *cum grano salis*, but not abandoned, because in practice they are indispensable. The philosophy of art did not find favourable or stimulating conditions in ancient philosophy, which was primarily "physics" and "metaphysics," and only secondarily and intermittently "psychology" or more precisely "philosophy of mind." To the philosophical problems of aesthetics it only referred in passing, either negatively, in Plato's denial of the value of poetry, or positively, in Aristotle's defence, which attempted to secure for poetry a realm of its own between that of history and that of philosophy, or again in the speculations of Plotinus, who for the first time united the previously disconnected concepts of "art" and "the beautiful." Other important thoughts of the ancients were that to poetry belonged "tales" (*μύθοι*) and not "arguments" (*λόγοι*), and that "semantic" (rhetorical or poetical) propositions were to be distinguished from "apophantic" (logical). Lately an almost wholly unexpected strain of ancient aesthetic thought has come to light, in the Epicurean doctrines expounded by Philodemus, in which imagination is conceived in what seems almost a romantic way. But these observations remained, for the time being, practically sterile; and the ancients' firm and sure judgment in artistic matters was never raised to the level and consistency of a theory, owing to an obstacle of a general nature—the objectivistic or naturalistic character of ancient philosophy, whose removal was only commenced, or demanded, by Christianity when it brought the problems of the soul into the focus of thought.

But even Christian philosophy, partly through its predominating transcendence, mysticism and asceticism, partly through the scholastic form which it borrowed from ancient philosophy and with which it remained content, while it raised the problems of morality in an acute form, and handled them with delicacy, did not penetrate deeply into the mental region of imagination and taste, just as it avoided the region which corresponds to it in the sphere of practice, the region of passions, interests, utility, politics and economics. Just as politics and economics were conceived moralistically, so art was subordinated to moral and religious allegory; and the germs of aesthetics scattered through the ancient writers were forgotten or only superficially remembered. The philosophy of the Renaissance, with its return to naturalism, revived, interpreted and adapted the ancient poetics and rhetorics and treatises on the arts; but though it laboured long at "verisimilitude" and "truth," "imitation" and "the idea," "beauty" and the mystical theory of beauty and love, "catharsis" or the purgation of passion, and the problems of the literary kinds, traditional and modern, it never reached a new and fruitful principle. No thinker arose capable of doing for the Renaissance treatises on poetry and art what Machiavelli did for political science, asserting with emphasis, not merely by the way and as an admission, its original and autonomous character.

Much more important in this respect, though its importance was long overlooked by historians, was the thought of the later Renaissance, known in Italy as the *seicento*, Baroque, or the literary and artistic decadence. This was the time at which the distinction was first insisted upon between the "intellect" and a faculty called *ingegno, ingenium*, "wit" or "genius," as especially inventive of art; and, corresponding to this, a faculty of judgment, which was not ratiocination or logical judgment, because it judged "without discourse" or "without concepts," and came to be called "taste." These terms were reinforced by another, which appeared to denote something not determinable in logical concepts and in some way mysterious: *"nescio quid"* or *"je ne sais quoi"*; an expression particularly frequent in Italy (*non so che*), and imitated in other countries. At the same time were sung the praises of the enchantress "imagination," of the "sensible" or "sensuous" element in poetic imagery, and of the miracles of "colour," in painting, as opposed to "drawing" which seemed not altogether free from an element of cold logic These new intellectual tendencies were somewhat turbid, but at times were purified and raised to the level of reasoned theory, *e g.*, Zuccolo (1623), who criticized "metric art" and replaced its criteria by the "judgment of sense," which to him meant not the eye or the ear but a higher power united to the senses; Mascardi (1636), who rejected the objective and rhetorical distinction between the styles, and reduced style to the particular individual manner arising out of the particular "wit" of each writer, thus asserting the existence of as many styles as there are writers; Pallavicino (1644), who criticized "verisimilitude" and assigned to poetry as its proper domain that of "first apprehensions" or imaginations, "neither true nor false"; and Tesauro (1654), who tried to work out a logic of rhetoric as opposed to the logic of dialectic, and extended the rhetorical forms beyond merely verbal form, to pictorial and plastic form.

Cartesianism, to which we have already referred, though, in the hands of Descartes and his successors, hostile to poetry and imagination, from another point of view, as stimulating enquiry into the subject or the mind, helped these scattered efforts (as we have said) to consolidate themselves into a system and to search for a principle to which the arts could be reduced; and here too the Italians, welcoming Descartes' method but not his rigid intellectualism or his contempt for poetry, art and imagination, wrote the first treatises on poetry in which the concept of imagination played a central or leading part (Calopreso 1691, Gravina 1692 and 1708, Muratori 1704 and others). These had considerable influence on Bodmer and the Swiss school, and, through them, on the new German criticism and aesthetics and that of Europe at large; so that a recent writer (Robertson) could speak of "the Italian origin of romantic aesthetics."

These minor theorists led to the work of G. B Vico, who in his *Scienza nuova* (1725–1730) propounded a "poetic logic" which he distinguished from "intellectual logic"; regarded poetry as a mode of consciousness or theoretic form preceding the philosophical or reasoning form, and asserted as its sole principle the imagination, which is strong in proportion as it is free from ratiocination, its enemy and destroyer; praised as father and prince of all true poets the barbaric Homer, and with him, though impaired by theological and scholastic culture, the half-barbaric Dante; and attempted, though without success, to discern English tragedy and Shakespeare, who, though undiscovered by Vico, would, had he known him, certainly have been his third barbaric and supreme poet. But in aesthetics as elsewhere, Vico in his lifetime founded no school, because he was before his time, and also because his philosophical thought was concealed

beneath a kind of historical symbolism. "Poetic logic" only began to make progress when it reappeared in a far less profound shape, but in a more favourable environment, in the works of Baumgarten, who systematized an aesthetics of a somewhat hybrid Leibnitzian origin, and gave it various names, including *ars analogi rationis, scientia cognitionis sensitivae, gnoseologia inferior,* and the name it has retained, *aesthetica* (*Meditationes,* 1735; *Aesthetica,* 1750–58).

The school of Baumgarten, or (more correctly) of Leibnitz, which both did and did not distinguish imaginative from logical form (for it regarded it as *cognitio confusa* and none the less ascribed to it a *perfectio* of its own), and the current of English aesthetics (Shaftesbury, Hutcheson, Hume, Home, Gerard, Burke, Alison, etc.), together with the essays on beauty and art which abounded at this time, and the theoretical and historical works of Lessing and Winckelmann, contributed to provide the stimulus, partly positive and partly negative, to the formation of the other masterpiece of 18th century aesthetics, the *Critique of Judgment* (1790) by Immanuel Kant, in which the author (after doubting it in the first *Critique*) discovered that beauty and art afford subject-matter for a special philosophical science—in other words, discovered the autonomy of the aesthetic activity. As against the utilitarians he showed that the beautiful pleases "without interest" (*i.e.*, utilitarian interest); against the intellectualists, that it pleases "without concepts", and further, against both, that it has "the form of purposiveness" without "representation of a purpose", and, against the hedonists, that it is "the object of a universal pleasure." In substance, Kant never went beyond this negative and generic assertion of the beautiful, just as, in the *Critique of Practical Reason,* once he had vindicated the moral law, he did not go beyond the generic form of duty. But the principles he had laid down were laid down once for all. After the *Critique of Judgment,* a return to hedonistic and utilitarian explanations of art and beauty could (and did) take place only through ignorance of Kant's demonstrations. Even the return to Leibnitz and Baumgarten's theory of art as confused or fanciful thinking would have been impossible, had Kant been able to link up his own theory of the beautiful, as pleasing apart from concepts, and as purposiveness without representation of purpose, with Vico's imperfect and inconsistent but powerful theory of the logic of imagination, which was to some extent represented in Germany at this time by Hamann and Herder. But Kant himself prepared the way for the reassertion of the "confused concept" when he ascribed to genius the virtue of combining intellect and fancy, and distinguished art from "pure beauty" by defining it as "adherent beauty."

This return to the tradition of Baumgarten is apparent in post-Kantian philosophy when it regards poetry and art as a form of the knowledge of the Absolute or the Idea, whether equal to philosophy, inferior and preparatory to it, or superior to it as in Schelling's philosophy (1800) where it becomes the organ of the Absolute. In the richest and most striking work of this school, the *Lectures on Aesthetic* of Hegel (1770–1831), art, with religion and philosophy, is placed in the "sphere of the absolute mind," where the mind is set free from empirical knowledge and practical action, and enjoys the beatific thought of God or the Idea. It remains doubtful whether the first moment in this triad is art or religion; different expositions of his doctrine by Hegel himself differ in this respect; but it is clear that both, art and religion alike, are at once transcended and included in the final synthesis which is philosophy. This means that art, like religion, is substantially an inferior or imperfect philosophy, a philosophy expressed in imagery, a contradiction between a content and a form inadequate to it which only philosophy can resolve. Hegel, who tended to identify the system of philosophy, the dialectic of concepts, with actual history, expressed this by his famous paradox of the death of art in the modern world, as incapable of subserving the highest interests of the age.

This conception of art as philosophy, or intuitive philosophy, or a symbol of philosophy, or the like, reappears throughout the idealistic aesthetics of the first half of the 19th century, with rare exceptions, *e.g.*, Schleiermacher's *Lectures on Aesthetic* (1825, 1832–33) which we possess in a very incomplete form. In spite of the high merit of these works, and the enthusiasm for poetry and art which they express, the reaction against this type of aesthetics was, at bottom, a reaction against the artificial character of the principle on which they were based. This reaction took place in the second half of the century, simultaneously with the general reaction against the idealistic philosophy of the great post-Kantian systems. This anti-philosophical movement certainly had its significance as a symptom of discontent and of a desire to find new paths, but it did not produce an aesthetics correcting the errors of its predecessors and carrying the problem a stage further. In part, it was a breach in the continuity of thought; in part, a hopeless attempt to solve the problems of aesthetics, which are philosophical problems, by the methods of empirical science (*e.g.*, Fechner); in part, a revival of hedonistic and utilitarian aesthetic by a utilitarianism resting on association of ideas, evolution and a biological theory of heredity (*e.g.*, Spencer). Nothing of real value was added by the *epigoni* of idealism (Vischer, Schasler, Carriere, Lotze, etc.), or the followers of the other early 19th century philosophical movements, *e.g.*, the so-called formalistic aesthetics (Zimmermann) derived from Herbart, or the eclectics and neo-Kantists, who, like all the rest, laboured at two abstractions, "content" and "form" ("aesthetics of content" and "aesthetics of form"), and sometimes tried to fasten the two together, failing to see that by so doing they were only uniting two fictions into a third. The best thoughts on art in this period are to be found not in the professional philosophers or aestheticians but in the critics of poetry and art, *e.g.*, De Sanctis in Italy, Baudelaire and Flaubert in France, Pater in England, Hanslick and Fiedler in Germany, Julius Lange in Holland, etc. These writers alone make amends for the aesthetic trivialities of the positivistic philosophers and the empty artificiality of the so-called idealists.

The general revival of speculative thought led to greater successes in aesthetics in the first decades of the 20th century. Especially noteworthy is the union which is taking place between aesthetics and the philosophy of language, facilitated by the difficulties under which linguistic, conceived as the naturalistic and positivistic science of the phonetic laws of language and similar abstractions, is labouring. But the most recent aesthetic productions, because they are recent and still in process of development, cannot as yet be historically placed and judged.

BIBLIOGRAPHY.—The chief monuments of aesthetic thought have already been referred to in the foregoing outline. It may be added that the latest revision of the text of Aristotle's *Poetics,* together with a commentary, is that of A. Rostagni (Turin, 1927), and that the fragments of the Epicurean Philodemus (polemic against Neoptolemus of Parium) have been edited by Jensen (*Philodemos uber die Gedichte Funftes Buch,* Berlin, 1923). Of Vico's second *Scienza nuova* the complete critical edition is that of F. Nicolini (Bari, 1911–16). Of Baumgarten, there is a reprint of the *Meditationes philosophicae de nonnullis ad poema pertinentibus* (1735), edited by Croce, Naples, 1900, but the *Aesthetica,* a very rare book, has unfortunately not been reprinted, though a previously unpublished course of Baumgarten's lectures on aesthetics has been published by B. Poppe (*A. G. Baumgarten·* Berne-Leipzig, 1907). Of Hegel's *Vorlesungen uber die Aesthetik,* which we possess in Hotho's redaction (ed. 2, Berlin, 1842–43).

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**AESTHETICS, EXPERIMENTAL.** Great artists throughout the centuries have contributed to an empirical aesthetic in the broad sense of the term. Some of them have given us extensive treatises based upon an analysis of their own methods of artistic production, or upon an investigation of existing works of art. Hogarth, for example, examined many forms of architecture, as well as the lines of the human figure, in a search for a norm of beauty which he thought he had found in the serpentine line, and Goethe in his *Farbenlehre* has made keen observations in regard to the aesthetics of colour. From the long list of names might also be mentioned Leonardo da Vinci, Sir Joshua Reynolds and M. E. Chevreul. G. Th. Fechner, however, is generally considered the founder of experimental aesthetics. He not only discussed the formal, or direct, and the associative factors underlying beauty on the basis of his experience of works of art, but he devised experiments in order to settle scientifically the question of the most pleasing proportions in geometrical forms and in line division. This problem had engaged the attention of a number of writers, whose results are in strong disagreement. Wolff insisted upon the proportion of 1:1, while Adolf Zeising thought the proportion of the golden section (1:1·618) to be the most pleasing, on the principle that it gives the greatest possible diversity in a harmonious unity. It was the proportion of the golden section that Fechner desired to put to experimental proof. He spread figures of different sizes, such as ellipses, before the observer, with instructions to choose the one which seemed the most pleasing, or he had the person construct a figure according to the most pleasing proportion. It was these two methods of choice and construction, together with that of use, which he proposed as the proper empirical methods of investigation, and these methods have continued to be employed up to the present day. Fechner found the golden section to hold in many instances, but he also found the proportions of 1:1 and 1:3 to be pleasing under certain circumstances. Lightner Witmer thought that Fechner used too few figures, and that the experiments were not properly controlled. He therefore used a serial order of figures with the least perceptible difference of proportion between them. He also had the figures compared in pairs. His results do not always agree with those of Fechner, but he established the importance of the golden section for rectangles, ellipses and line division. An interesting fact came to light in experiments conducted by R. P. Angier. His subjects divided a line at what seemed to them the most pleasing point. Although several persons came near the golden section, no one actually chose it. Nevertheless, the average of all observers was almost exactly the golden section. His results served as a warning not to place too much weight upon averages in the search for an aesthetic norm. In general, however, it may be said that the golden section and symmetry are pleasing, that a division very near the middle and one which makes the shorter line less than a quarter of the length of the whole line are displeasing.

Numerous experiments have been made upon form and balance, with the principal aim of obtaining a psychological explanation of the pleasing effects. T. H. Haines and A. E. Davies, from their work with a series of cards having a constant length and varying width, decided that eye-movements, associations, balance between forces of attention, and suggestion, were the factors which determined the aesthetic effect. Ethel D. Puffer made an extensive study of balance by the use, among other objects, of lines of various sizes and in various positions. She found that the best aesthetic balance generally corresponded to the mechanical balance, and explained the results in terms of interest which, in the last analysis, meant for her a balance of motor impulses. L. J. Martin asserted that our preference for lines and shapes depends very much upon our attitude toward the objects we are judging. A slanting line, when interpreted as a bad vertical, is displeasing, but when we think of it as a horizontal line which is raising itself to a vertical, it is pleasing. F. Sander believes that absence of feelings of tension produces a restful effect such as is experienced in viewing Greek architecture, while vivid tensions underlie our reactions to Romanesque and Gothic architecture.

The theory of empathy made famous by Th. Lipps has also been offered frequently as an explanation of the aesthetic feelings aroused by lines, forms and other properties of art objects. A modern psychological interpretation of this theory is that the individual imitates in terms of his own reactions the patterns suggested by the art object. These reactions are projected by the individual into the external object and are perceived not as his own but as the dynamic qualities of the object. Experiments furnish some support for this theory of empathy in that implicit or nascent muscular activity related to the stimulus-situation has been detected during the act of perception.

The empathic value of lines in expressing emotional moods has been demonstrated in experiments in which subjects have been asked to draw lines to express emotional states and qualities or in which they have been asked to match various types of lines with descriptive adjectives. The agreement concerning the expressiveness of lines is much greater than chance expectation. For example, moods with little motor expression such as sadness and quietness are represented in the drawings by wide sweeping curves whereas moods of excitement are represented by sharp curves and acute angles. Investigations of the ability of children to approximate adult judgment in this field show that even kindergarten pupils do better than chance, that there is a positive correlation between this ability and age and that artistic children do better than non-artistic children. The early recognition of the expressive qualities of pure lines argues against an association explanation and suggests an empathic basis in the type of bodily response occurring in a given emotional condition.

The modern trend, however, is to emphasize the relationship of the line to the form of which it is a part, or the relationship of the figure to the total pattern in which it appears. As early as 1903 Legowski concluded from his experiments on judgments for the same type of figures of varying proportions that the sensibility of the relationships was the cause of their pleasantness. More recently Birkhoff has studied form preference and used as a measure of aesthetic pleasure the relation between order and complexity. The elaborations of his basic formula, $M = \frac{O}{C}$ ($M$ = aesthetic measure, $O$ = order and $C$ = complexity) are not as objective as their mathematical expression might suggest, but Birkhoff's results do indicate that the degree of pleasure is related to ability to resolve complex relationships into a unified pattern—a very old aesthetic doctrine.

**Colour.**—Goethe in his *Farbenlehre* discussed the moods aroused by colours, and the different psychological effects of different colour combinations. Chevreul studied colours from the aesthetic standpoint, and remarked that complementary colours form the most pleasing combinations, as there is a harmony in the contrast, and half a century later Bezold stated that the colours which are very nearly, but not quite, complementary form the best combinations. Towards the end of the last century, Jonas Cohn and August Kirschmann performed controlled experiments on colour in the manner advocated by Fechner. Both men found contrast to be pleasing, and Cohn's results led him to conclude that saturated colours are in most instances preferred. From about this time the number of treatises on colour preferences began to grow rapidly, and the papers have covered a large field of investigation. The effects of hue, saturation and brightness, together with such factors underlying preference as the time of exposure of the colours, suggestion and association, have been studied. A large number of treatises deal with the colour preferences of infants and school children, and the changes in colour preference which occur with age. Comparative studies have also been made of the colour preferences of the sexes and of races. The experiments were done under such widely different conditions that in many cases they are hardly comparable, and the results are so numerous and varied that they are difficult to summarize. In no instance was there any great agreement in regard to the preference either for single colours or for combinations, and often there was not even a great constancy in the choice of the individual observer. All that one can indicate are general tendencies. Red and blue seem to be the favourite colours, and orange and yellow usually rank low. It appears from the mass of information that has been collected that men have the strongest preference for blue and women for red. A typical order of preference is blue, red, purple, green, orange, yellow, which would mean that the colours at the ends of the spectrum have the best chance of being chosen as the most pleasing. Also, saturated colours have a strong attraction, but are not always preferred. As Titchener has remarked, there seem to be two types of observers, one of which prefers saturated colours, the other definitely prefers unsaturated or what are popularly called artistic colours. E. Bullough has made an analysis of the psychological attitude of persons toward colours, and has found that there are four main types of judgments: the objective, where the peculiarities of the colours such as clarity are observed; the physiological, where the aspects of warmth, hardness, etc., are noted; the associative, where the colours remind the observer of some experience; and the character judgment, where the colours are expressive of mood. It seems, then, that our preference depends very much upon our attitude. Indeed, as von Allesch has stated, the old talk of beauty and ugliness of colours has only relative meaning. All colours can be all things at the right moment and at the right place. Nevertheless, we may say that in general complementary colours seem to be pleasing in combination, and probably also those colours which are nearly complementary. On the other hand, colours which are neighbouring in the spectrum do not seem to go together. Harmony, however, can generally be obtained from the inharmonious combination of two colours by the proper selection of a third colour to form a triad.

**Sound.**—The most important work on the psychology of music is that of Carl Stumpf. His book *Tonpsychologie* (1890) is a classic in this field and contains, among many theories and facts of importance, his psychological theory of consonance, which is based upon an empirical study of the perception of tonal combinations. For Stumpf, degree of consonance is correlated with degree of fusion of

the two tones of a musical interval In his subsequent writings, he has vigorously attacked the physical theory of consonance of Herman v. Helmholtz and F. E. Kruger. Stumpf has also done extensive work upon the tonal quality of vowels and consonants One of his latest investigations in the auditory field is a comparison of singing and talking, which he finds not fundamentally different In speaking we use for the most part a continuous change in tone, while in singing we use discrete tonal steps. H T. Moore has shown experimentally that, up to a certain point, the pleasantness of tonal intervals grows with our experience of them, which accounts for the gradual change in our attitude toward consonance and dissonance. O. Abraham and E. M. von Hornbostel, in their analysis of tonal intervals, have discovered two factors underlying the experience, one a qualitative the other a quantitative, which they call distance or width and accord quality, respectively. C E. Seashore has devised a series of tests which can be given by means of phonograph records In his latest work he describes the results obtained by photographing the vibrations of the singing voice. He has detected the vibrato, or synchronous oscillations of pitch and rate of five to eight per second in artistic singing.

In experiments upon the appreciation of pictures the introspective method has usually been employed. O. Kulpe showed pictures for three seconds each to a number of persons, and recorded their reports. He did not find evidence of empathy to support Lipps's theory. On the other hand, muscular sensations in a form which, according to Karl Groos, is called inner mimicry are present at times, but not always. A unique method of investigating the effect of pictures upon children was used by R. Schultze who photographed the children while they were looking at the pictures One was then able to judge from the photographs which picture the child had been looking at, as well as the mood which had been aroused.

A laboratory research in the field of literature which is suggestive, both from the point of view of method and content, is that of R. C. Givler. He showed conclusively the importance of the mere sound of words in conveying the meaning as well as the moods of poetry. Most of the investigations of the aesthetics and psychology of prose and poetry, however, have been in the nature of a direct analysis of the works themselves, or a study of the life of the artist, and do not come under experimental aesthetics in the narrow sense of that term, as used in this article. J. L. Lowes' *The Road to Xanadu* (1927) might, however, be mentioned as a model piece of research of this nature. Comparing the contents of a note-book left by Coleridge with the text of *The Rhyme of the Ancient Mariner* and *Kubla Khan,* Lowes has been able to analyse most convincingly the subconscious mind of that poet. Freud and his followers have also made numerous analyses of the subconscious minds of artists. Their results will undoubtedly be of interest to those persons who believe in the psychoanalytic method, and even the sceptic will find some suggestive material in their writings.

A promising modern development in experimental aesthetics is the genetic investigation of artistic creation and appreciation. The fundamentals of preference for form and pattern are well on their way toward assimilation by the time children enter grade school. Children between the ages of two and five years prefer balance in tri-dimensional designs to imbalance. Controlled observation confirms the popular belief in the sensitivity of young children to rhythm in music Graphic rhythm (regular repetition in two-dimensional form) is preferred in pictorial presentation by five-year olds Children of this age ever show an appreciation of rhythm in abstract design. One study of talented children, aged five to seven years, definitely established the presence of creative artistic imagination at this age level The pictures painted by the children were not generalized depictions of simple objects or stereotyped forms but were of a compositional character. Moreover, these talented novices showed a critical attitude toward their work characteristic of the professional. They were seldom satisfied with their first efforts and usually expressed in specific terms a critical evaluation of each stage of the production as they went along.

An interesting problem in the psychology of art is the relationship among the various fields of artistic expression (music, painting, etc. Critics with a classical bias have affirmed the uniqueness of each of the arts, whereas artists of a less conservative bent have sometimes assumed a common basis and a common method of appeal to all the arts. An extreme example is the colour organ which attempts to use the temporal presentation of music in the visual field. The writings of Gertrude Stein and the paintings of some surrealists are likewise attempts to cut across the conventional bounds of the art fields in the belief in the unity of all psychological experience. The problem has been approached experimentally by comparing the moods aroused by painting with those aroused by music and by comparing the qualities of the various sensory modalities. J. Cowles presented 33 subjects with seven pictures as they listened to seven successive musical selections. They were asked to specify the picture which best suited each musical selection. A fairly high degree of agreement was found in the pairing of the visual and the auditory stimuli. Pictures suggestive of activity were nearly always paired with musical selections of prominent dynamic changes. That similar moods can be established in the individual through appeals to the different senses does not mean, however, that sensory qualities of the various sensory modalities have even a rough equivalence The eye and the ear as well as the other sense complexes give rise to distinctive qualities and even the intensive [illegible] these qualities are not strictly comparable. Moreover, Karwoski and Odbert in a study of colour music have challenged the absolute nature of coloured hearing (that form of synaesthesia in which people experience a definite and a constant colour sensation when a certain tone is sounded). They found no constant relationship between tone and colour which held for all subjects and even the individual subject showed considerable variability in his visual response The photism reported depended upon the total stimulus-situation and upon the familiarity with the musical selection as well as upon the tones themselves Experimental psychology corroborates those critics who would keep apart the various arts in their objective techniques though not necessarily in their appeal to affective experience.

BIBLIOGRAPHY.—For a history of experimental aesthetics up to 1899 the reader is referred to J. Larguier des Bancels's article "Les Méthodes de l'esthétique expérimentale" in *L'Année Psychologique* vi., pp. 144–190 (1899). [illegible]'s little work, *An Introduction to the Experimental Psychology of Beauty* (1913), describes a few typical experiments upon colour, form, balance and symmetry, and the [illegible] contemplation of pictures. C. S. Myers's *Text-book of Experimental Psychology,* pt. 1, ch. xxiv. (1922), deals primarily with the methods employed in experimental aesthetics. For a general treatment of psychological aesthetics *see* W. Wundt, *Physiologische Psychologie,* iii., pp. 123–209 (5th ed., Leipzig, 1902). For a summary of the work on aesthetics of colour *see* [illegible], *An Introduction to the Study of Colour Vision* (1924), and M. Luckiesh, *The Language of Colour* (1920) For a history of the problem of tonal intervals *see* M. Guernsey, "The Rôle of Consonance and Dissonance in Music," *Amer. J. Psychol.,* xl, pp. 173–204 (1928). The articles of Carl E. Seashore and his pupils upon the experimental psychology of music are to be found in the Iowa Studies in Psychology, *Psychol. Rev. Monog. Supl.,* Nos. 69, 108, 140, 167, 168; C. E. Seashore, *Psychology of Music* (1938). A comprehensive summary of the experimental work in music can be found in C. M. Diserens and H. Fine, *A Psychology of Music* (1939). For the psychology of rhythm *see* C. M. Ruckmick, "A Bibliography of Rhythm," *Amer. J. Psychol.,* 26, pp. 457–459 (1915); 29, pp. 214–218 (1918); 35, pp. 407–413 (1924). For genetic studies of artistic ability and creation *see* "Studies in the Psychology of Art," *Psychol. Monog.,* 45, pp. 1–146 (1933); 48, pp. 1–172 (1936). For other special studies *see* G. D. Birkhoff, *Aesthetic Measure* (1933); T. Karwoski and H. S. Odbert, "Colour-Music," *Psychol. Monog.,* 50, No. 222 (1938); G. T. Buswell, *How People Look at Pictures* (1935); N. C. Meier, "Studies in the Psychology of Art," *Psychol. Monog,* 51, pp. 1–158 (1939).

(H. S. L.; D. KA.)

**AESTIVATION,** literally "summer residence," a term used in zoology for the condition of torpor into which certain animals pass during the hottest season in hot and dry countries, contrasted with the similar winter condition, hibernation. In botany the word is used of the folded arrangement of the petals in a flower before expansion in the summer, contrasted with "vernation" of leaves which unfold in the spring. *See* HIBERNATION.

**AETA,** a Negrito tribe of the Philippine islands, woolly-haired, dark-skinned, dwarfish (the male stature is about 4ft. 9in.) inhabiting the mountainous districts of the larger islands and some of the smaller. They are characterized by a large and clumsy foot with abnormally divergent great toe. The social unit is the family; polygamy is permitted, but monogamy prevails. The dead are normally buried, but the bodies of those whom it is wished to honour are exposed on platforms or in trees. Bows and poisoned arrows are used, long spears and darts barbed with flint or shell. Fire is made by means of a flexible thong pulled to and fro in a notch in a cleft stick. They pray to a great serpent to show them yams and honey.

The Aeta were long recognized as the owners of the soil in spite of the arrival of Malayan settlers, and in Luzon they levied taxes upon the Tagalog and other tribes (until these arrived in such numbers as to push them back into the hills) taking the heads of defaulters. For much longer, perhaps even yet, they kept a debit and credit account of heads with the Igorots and other neighbours.

*See* Reed, *Negritos of Zambales,* Ethnolog. Survey of the Philippines, II. (1904): Worcester, *Non-Christian tribes of N. Luzon,* Philippine Jnl of Science, I. (1906); A. L. Kroeber, *Peoples of the Philippines,* American Museum of Natural History (1919).

(J. H. H.)

**AETHELBALD,** king of Mercia, succeeded Ceolred, A.D. 716, at the beginning of the period of Mercian supremacy. His activities as a warrior were slight; in 733 he raided Somerset as far as Somerton, and led unimportant campaigns against the Northumbrians and the Welsh. In 752 Cuthred of Wessex led a successful raid into Oxfordshire against him. Aethelbald encouraged the development of the church, making large grants of land, and publishing a decree in 749 which freed ecclesiastical lands from all obligations to the king except the *trinoda necessitas.*

*See* Bede, *Hist. Ecc.* (ed. Plummer), v. 23 and Continuatio *s.a.* 740, 750, 757; *Saxon Chronicle* (Earle and Plummer), *s.a.* 716, 733, 737.

740, 741, 743, 755; Mabillon, *Acta Sanctorum*, ii pp. 264, 275–276, 279, 283–284; P. Jaffé, *Monumenta Moguntiaca*, iii. pp 168–177, W. de G. Birch, *Cartul. Saxon.*, 178 (1885–93).

**AETHELBALD,** king of Wessex, was the son of Aethelwulf, with whom he led the West Saxons to victory against the Danes at Aclea, 851. According to Asser he rebelled against his father on the latter's return from Rome in 856, and deprived him of Wessex, which he ruled until his death in 860. On his father's death in 858 he married his widow, Judith.

*See* Asser, *Life of Alfred* (W. H. Stevenson, 1904), 12; *Saxon Chronicle, s.a.* 851, 855, 860.

**AETHELBERT,** king of Kent, son of Eormenric, came to the throne in A.D. 560. Aethelbert's supremacy, described by Bede as extending in 597 to the Humber, can have been little more than nominal, though he exercised stricter sway over Essex, where his nephew, Sabert, was king. An attempt to extend his kingdom westwards was defeated in 568 by Ceawlin at Wibbandune. Aethelbert's reign is chiefly remarkable for the introduction of Christianity. He married a Christian princess, Berta, daughter of Charibert, king of Paris, who brought over a bishop as private confessor. When in 597 Augustine landed in Thanet, the king treated his mission tolerantly, gave him a dwelling in Canterbury and allowed monks to preach there, afterwards being baptized himself, but making no attempt to force conversion on his subjects. In 604 he founded the see of Rochester, and his influence established Mellitus at London in the same year. He published a code of laws, the first of its kind, containing a list of money fines for various offences against the clergy.

BIBLIOGRAPHY.—*See* Stubbs, *Dict. of Christian Biog. Ethelbert;* Bede, *Hist. Ecc.* (Plummer i. 25, 26, ii. 3, 5); *Saxon Chronicle* (Earle and Plummer), *s.a.* 568.

**AETHELBERT,** king of the West Saxons, succeeded to the under-kingdom of Kent during the lifetime of his father, Aethelwulf, and retained it until the death of his elder brother, Aethelbald, in 860, when he became sole king of Wessex and Kent till his death in 865. His reign was marked by two serious attacks by the Danes, who were repelled in 860 by the levies of Hampshire and Berkshire, though not before they had sacked Winchester, while in 865 they ravaged Kent after agreeing to take money for peace. Aethelbert was buried at Sherborne.

BIBLIOGRAPHY.—*See* the *Saxon Chronicle* (Earle and Plummer), *s.a.* 860, 865; *King Alfred's Will;* W. de G. Birch, *Cartul. Saxon.*, 553.

**AETHELFLAED** or **ETHELFLEDA,** the "Lady of the Mercians," the eldest child of Alfred the Great, was married about 886 to Aethelred, earl of Mercia, to whom Alfred entrusted the control of Mercia. On the accession of her brother Edward, Aethelflaed and her husband continued to hold Mercia. In 907 they fortified Chester, and in 909 and 910 either Aethelflaed or her husband must have led the Mercian host at the battles of Tettenhall and Wednesfield (or Tettenhall-Wednesfield, if these battles are one and the same). It was probably about this time that Aethelred fell ill, and the Norwegians and Danes from Ireland unsuccessfully besieged Chester. Aethelflaed won the support of the Danes against the Norwegians, and seems also to have entered into an alliance with the Scots and the Welsh against the pagans.

In 911 Aethelred died, and Edward took over Middlesex and Oxfordshire. Except for this, Aethelflaed's authority remained unimpaired. In 912 she fortified "Scergeat" and Bridgnorth, Tamworth and Stafford in 913, Eddisbury and Warwick in 914, Cherbury, "Weardbyrig" and Runcorn in 915. In 916 she sent an expedition against the Welsh, which advanced as far as Brecknock. In 917 Derby was captured from the Danes, and the next year Leicester and York both submitted to her. She died in 918 at Tamworth (June 12), and was buried in St. Peter's Church at Gloucester. This noble queen, whose career was as distinguished as that of her father and brother, left one daughter, Aelfwyn. For some 18 months Aelfwyn seems to have wielded her mother's authority, and then, just before the Christmas of 919, Edward took Mercia into his own hands, and Aelfwyn was "led away" into Wessex. Aethelflaed and her husband wielded almost kingly authority; the royal title is often given them by the chroniclers.

See *The Saxon Chronicle, s.a.* (especially the Mercian register in MSS. B, C and D); Florence of Worcester; *Fragments of Irish Annals* (ed. O'Conor), pp. 227–237, D.N.B., *s.v.* (A. M.)

**AETHELFRITH,** king of Northumbria, is said to have come to the throne in A.D. 593, being the son of Aethelric (probably reigned 568–72) He married Acha, daughter of Ella (Aelle), king of Deira, whom he succeeded, probably in 605, expelling his son Edwin. In 603 he repelled the attack of Aidan, king of the Dalriad Scots, at Daegsastan, defeating him with great loss. Later in his reign, probably in 614, he defeated the Welsh in a great battle at Chester, and massacred the monks at Bangor who were assembled to aid them by their prayers. This war had a strategic importance in the separation of the North Welsh from the Strathclyde Britons In 617 Aethelfrith was defeated and slain at the river Idle by Raedwald of East Anglia, whom Edwin had persuaded to take up his cause.

*See* Bede, *Chronica Maiora*, §531; *Hist. Ecc.* (Plummer) i. 34, ii. 2; *Saxon Chronicle, s.a.* 593, 603, 605, 616; *Hist. Brittonum*, §§57, 63; *Annales Cambriae, s.a.* 613.

**AETHELING,** an Anglo-Saxon word meaning originally "of noble descent," but soon restricted to members of a royal family, and in the *Anglo-Saxon Chronicle* used almost exclusively for members of the royal house of Wessex. It was occasionally used after the Norman Conquest to designate members of the royal family. In the 10th century, the *wergild* of an aetheling was equal to that of an archbishop and one-half of that of a king.

**AETHELNOTH** (d. 1038), archbishop of Canterbury, known also as EGELNODUS or EDNODUS, was a son of the ealdorman Aethelmaer, and a member of the royal family of Wessex. He became a monk at Glastonbury, then dean of the monastery of Christ Church, Canterbury, and chaplain to King Canute, and on Nov. 13, 1020, he was consecrated archbishop of Canterbury. He appears to have exercised considerable influence over Canute, largely by whose aid he restored his cathedral at Canterbury. Aethelnoth, who was called the "Good," died on Oct. 29, 1038.

**AETHELRED,** king of Mercia, succeeded his brother Wulfhere in A.D. 675. In 676 he ravaged Kent, destroying the monasteries and churches and taking Rochester. Aethelred married Osthryth, the sister of Egfrith, king of Northumbria, but a quarrel arose between the two kings, presumably over the possession of the province of Lindsey, which Egfrith had won back at the close of the reign of Wulfhere. In a battle on the banks of the Trent in 679, the king of Mercia was victorious and regained the province. Aelfwine, the brother of Egfrith, was slain, but at the intervention of Theodore, archbishop of Canterbury, Aethelred agreed to pay a wergild for the Northumbrian prince and so prevented further hostilities. Osthryth was murdered in 697 and Aethelred abdicated in 704, choosing Coenred as his successor. He then became abbot of Bardney, and, according to Eddius, recommended Wilfrid to Coenred on his return from Rome. Aethelred died at Bardney in 716. *See* WILFRID.

BIBLIOGRAPHY.—Eddius, *Vita Wilfridi* (Raine), 23, 40, 43, 45–48, 57; Bede, *Hist. Ecc.* (ed. Plummer), iii. 11, iv. 12, 21; *Saxon Chronicle, s.a.* 676, 679, 704, 716. (F. G. M. B.)

**AETHELRED I.,** king of Wessex and Kent (866–871), was the fourth son of Aethelwulf of Wessex, and should, by his father's will, have succeeded to Wessex on the death of his eldest brother Aethelbald. He seems, however, to have stood aside in favour of his brother Aethelbert, king of Kent, to whose joint kingdoms he succeeded in 866. Aethelred's reign was one long struggle against the Danes. In the year of his succession a large Danish force landed in East Anglia, and in the year 868 Aethelred and his brother Alfred went to help Burgred, or Burhred, of Mercia, against this host, but the Mercians soon made peace with their foes. In 871 the Danes encamped at Reading, where they defeated Aethelred and his brother, but later in the year the English won a great victory at "Aescesdun." A fortnight later they were defeated at Basing, but partially retrieved their fortune by a victory at "Maeretun" (perhaps Marden, in Wiltshire), though the Danes held the field. In the Easter of this year Aethelred died, perhaps of wounds received in the wars against the Danes, and was buried at Wimborne.

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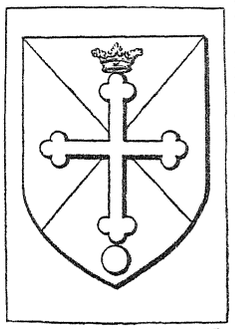
**II.** or **ETHELRED** (*c.* 968–1016), king of the English (surnamed THE UNREADY; *i.e.*, without *rede* or counsel), son of King Edgar by his second wife, Aelfthryth, was born in 968 or 969 and succeeded to the throne on the murder of his half-brother Edward (the Martyr) in 978. In the year after his accession the Danish invasions recommenced, though as yet their object was plunder only, not conquest. For an account of the repeated invasions, which gathered strength as time went on, *see* ENGLISH HISTORY. Aethelred's policy of buying off the raiders failed, and the massacre of Danes in England carried out by his orders on St. Brice's Day (Dec. 2, 1001) only made matters worse. Next year Sweyn returned, his hostility fanned by the desire for revenge. For two years he ravaged and slew; in 1003 Exeter was destroyed; Norwich and Thetford were sacked in 1004. No effectual resistance was offered, despite efforts here and there; disorganization of the country was complete In 1005 the Danes were absent in Denmark, but they came back next year, and emboldened by the utter lack of resistance, they ranged far inland. In 1007 Aethelred bought them off for a larger sum than ever (£36,000), and for two years the land enjoyed peace. In 1009, however, in accordance with a resolution made by the witan in the preceding year, Aethelred collected such a fleet "as never before had been in England in any king's day"; but owing to a miserable court quarrel the effort came to nothing. The king then summoned a general levy of the nation, with no better result. Just as he was about to attack, the traitor Edric prevented him from doing so, and the opportunity was lost. In 1010 the Danes returned, to find the kingdom more utterly disorganized than ever. "There was not a chief man in the kingdom who could gather a force, but each fled as he best might; nor even at last would any there resist another." Incapable of offering resistance, the king again offered money, this time no less than £48,000. While it was being collected, the Danes sacked Canterbury and slew the archbishop Alphege. The tribute was paid soon afterwards; and about the same time the Danish leader Thurkill entered the English service.

From 1013 an important change is discernible in the character of the Danish attacks, which now became definitely political in their aim. In this year Sweyn sailed up the Trent and received the submission of northern England, and then, marching south, attacked London. Failing to take it, he hastened west and at Bath received the submission of Wessex. Then he returned northwards, and after that "all the nation considered him as full king." London soon acknowledged him, and Aethelred, after taking refuge for a while with Thurkill's fleet, escaped to Normandy. Sweyn died in Feb. 1014, and Aethelred was recalled by the witan. At once he hastened north against Canute, Sweyn's son, but Canute sailed away, only to return next year, when the traitor Edric joined him and Wessex submitted. Canute and Edric harried Mercia, and were preparing to reduce London, when Aethelred died there on April 23, 1016. Weak, self-indulgent, improvident, he had pursued a policy of opportunism to a fatal conclusion.

Aethelred's wife was Emma, or Aelfgifu, daughter of Richard I. the Fearless, duke of the Normans, whom he married not later than 985. After the king's death Emma married Canute the Great, and after his death in 1035 she struggled hard to secure England for her son, Hardicanute. In 1037, however, when Harold Harefoot became sole king, she was banished; she went to Flanders, returning to England with Hardicanute in 1040. In 1043 Edward the Confessor seized the greater part of Emma's great wealth, and the queen lived in retirement at Winchester until her death on March 6, 1052. By Aethelred Emma had two sons, Edward the Confessor and the aetheling Aelfred (d. 1036), and by Canute she was the mother of Hardicanute. Her marriage with Aethelred was an important step in the history of the relations between England and Normandy, and J. R. Green says "it suddenly opened for its rulers a distinct policy, a distinct course of action, which led to the Norman conquest of England. From the moment of Emma's marriage Normandy became a chief factor in English politics"

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**AETHELSTAN** (*c.* 894–940), Saxon king, was the son (probably illegitimate) of Edward the Elder. He had been the favourite of his grandfather Alfred, and was brought up in the household of his aunt Aethelflaed, the "Lady of the Mercians." On the death of his father in 924, Aethelstan succeeded him, and was crowned at Kingston shortly after.



AFTER G. M. COLLEN'S BRIT. SAXONICA

SHIELD OF AETHELSTAN

The cross boutonné, on a field of red and blue, is surmounted by a crest coronet of gold. The circle at the base is gold

One of Aethelstan's first public acts was to hold a conference at Tamworth with Sihtric, the Scandinavian king of Northumbria, and as a result Sihtric received Aethelstan's sister in marriage. In the next year Sihtric died and Aethelstan took over the Northumbrian kingdom. He now received, at Dacre, in Cumberland, the submission of all the kings of the island; viz., Howel Dda, king of West Wales, Owen, king of Cumbria, Constantine, king of the Scots, and Ealdred of Bamburgh, and henceforth he called himself "rex totius Britanniae." About this time (the exact chronology is uncertain) Aethelstan expelled Sihtric's brother Guthfrith, destroyed the Danish fortress at York, received the submission of the Welsh at Hereford, fixing their boundary along the line of the Wye, and drove the Cornishmen west of the Tamar, fortifying Exeter as an English city. In 934 he invaded Scotland by land and sea, perhaps owing to an alliance between Constantine and Anlaf Sihtricsson. The army advanced as far north as Dunottar, in Kincardineshire, while the navy sailed to Caithness. Simeon of Durham speaks of a submission of Scotland as a result; if it ever took place it was a mere form, for three years later we find a great confederacy formed in Scotland against Aethelstan. This confederacy of 937 was joined by Constantine, king of Scotland, the Welsh of Strathclyde, and the Norwegian chieftains, Anlaf Sihtricsson and Anlaf Godfredsson, who, though they came from Ireland, had powerful English connections. A great battle was fought at Brunanburh (perhaps Brunswark or Birrenswark hill in south-east Dumfriesshire), in which Aethelstan and his brother Edmund were completely victorious. England had been freed from its greatest danger since the days of the struggle of Alfred against Guthrum.

Aethelstan was the first Saxon king who could claim in any real sense to be lord paramount of Britain. In his charters he is continually called "rex totius Britanniae," and he adopts for the first time the Greek title *basileus*. This was not merely an idle flourish, for some of his charters are signed by Welsh and Scottish kings as *subreguli*. Further, Aethelstan was the first king to bring England into close touch with continental Europe. By the marriage of his half-sisters he was brought into connection with the chief royal and princely houses of France and Germany. His sister Eadgifu married Charles the Simple, Eadhild became the wife of Hugh the Great, duke of France, Eadgyth was married to the emperor Otto the Great, and her sister, Aelfgifu, to a petty German prince. Embassies passed between Aethelstan and Harold Fairhair, first king of Norway, with the result that Harold's son Haakon was brought up in England, and is known in Scandinavian history as Haakon Adalsteinsfóstri.

Aethelstan died at Gloucester in 940, and was buried at Malmesbury, an abbey which he had munificently endowed during his lifetime. Apparently he was never married, and he certainly had no issue. A considerable body of law has come down to us in Aethelstan's name. The chief collections are those issued at Grately, in Hampshire, at Exeter, at Thunresfeld, and

the *Iudicia civitatis Lundonie*. In the last-named one personal touch is found when the king tells the archbishop how grievous it is to put to death persons of 12 winters for stealing. The king secured the raising of the age limit to 15

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle, sub ann.*; William of Malmesbury *Gesta Regum*, i. 141–[illegible] Series, containing valuable original information (*v.* Stubbs' Introduction, II. lx., lxvii.); *Birch Cartul. Saxon.* vol. ii. Nos. 641–747; A. S. Laws (ed. Liebermann), i. 146–183, Aethelweard, Florence of Worcester. Secondary: *Saxon Chronicle* (ed. Plummer) vol. ii. p. 132–142; D. N. B., *s.v.*

(A. M.)

**AETHELWEARD** or **ETHELWARD,** Anglo-Saxon historian, was the great-grandson of Aethelred, the brother of Alfred, and ealdorman or earl of the western provinces (*i.e.*, probably of the whole of Wessex). He was the author of a Latin chronicle extending to the year 975. Up to the year 892 he is largely dependent on the *Saxon Chronicle*, with a few details of his own; later he is largely independent of it. He was the friend and patron of Aelfric, the grammarian.

BIBLIOGRAPHY.—Primary: *The Saxon Chronicle*, 994 E; Birch, *Cartularium Saxonicum;* A. S. Laws (ed. Liebermann), pp. 220–24; *Fabii Ethelwerdi Chron.*, Mon. Hist. Brit., pp. 449–54. Secondary: Plummer, *Saxon Chronicle*, vol. ii. p. ci.; Napier and Stevenson, *Crawford Charters*, pp. 118–20; D.N.B., *s.v.*

**AETHELWULF,** king of the West Saxons, succeeded his father, Egbert, in A.D. 839. Aethelwulf's reign was chiefly occupied with struggles against the Danes. After the king's defeat 843–44, the Somerset and Dorset levies won a victory at the mouth of the Parret (*c.* 850). In 851 Ceorl, with the men of Devon, defeated the Danes at Wigganburg, and Aethelstan of Kent was victorious at Sandwich; despite this the Danes wintered in England that year for the first time. In 851 also Aethelwulf and Aethelbald won their great victory at Aclea, probably the modern Ockley. In 853 Aethelwulf subdued the North Welsh, in answer to the appeal of Burgred of Mercia, and gave him his daughter Aethelswith in marriage. The year 855 is the date of the Donation of Aethelwulf and of his journey to Rome with Alfred. On his way home he married Judith, daughter of Charles the Bold. According to Asser he was compelled to give up Wessex to his son Aethelbald on his return, and content himself with the eastern under-kingdom. He died in 858.

*See* Asser, *Life of Alfred* (W. H. Stevenson, 1904), 1–16; *Saxon Chronicle, s.a.* 823, 836, 840, 851, 853, 855.

**AETHER:** *see* ETHER (PHYSICS).

**AETHICUS** (=ETHICUS) **ISTER,** "the philosopher of Istria," the supposed but unknown author of a description of the world written in Greek. An abridgment, under the title of *Cosmographia Ethici,* written in barbarous Latin, and wrongly described as the work of St. Jerome, probably belongs to the 7th century.

The name Aethicus is also attached to a geographical treatise probably dating from the 6th century, a reproduction of the cosmography of Julius Honorius.

BIBLIOGRAPHY.—D'Avezac (1852); Pertz (1853); Wuttke (1854); Riese's *Geographi Latini Minores* (1878); *see* also Bunbury, *History of Ancient Geography.*

**AETIOLOGY** or **ETIOLOGY,** strictly, science or philosophy of causation, but generally used to denote the part of any special science (and especially of that of medicine and disease) which investigates the causes and origin of its phenomena. An *aetiological myth* is one which is regarded as having been invented *ex post facto* to explain some fact, name, or coincidence, the true account or origin of which has been forgotten. Such myths were often based on grotesque philological analogies, according to which an existing connection between two personalities (cities, etc.) was traced back to a common mythical origin. The preferred spelling of the word in the United States is Etiology.

**AETION** or **EETION,** a Greek painter, mentioned by Cicero, Pliny, and Lucian. His most noted work, described in detail by Lucian (*Herodotus or Eetion*, 5), was a picture representing the marriage of Alexander and Roxana. Through a misunderstanding of the words of Lucian, Aetion has been supposed to belong to the age of Antonines; but there can be little doubt that he was a contemporary of Alexander and of Apelles (Brunn, *Geschichte der griechischen Kunstler*, ii. p. 243). Pliny gives his date as 350 B.C.

**AETIUS** (ah-ĕt'ĭ-oos) (fl. 350), surnamed "the Atheist," founder of an extreme sect of Arians, was a native of Coele-Syria He studied successively under the Arians, Paulinus, bishop of Antioch, Athanasius, bishop of Anazarbus, and the presbyter Antonius of Tarsus At the first synod of Sirmium he won a dialectic victory over the homoiousian bishops, Basilius and Eustathius who sought in consequence to stir up against him the enmity of Caesar Gallus. In 356 he went to Alexandria with Eunomius (*q.v.*) in order to advocate Arianism, but he was banished by Constantius Julian recalled him from exile, bestowed upon him an estate in Lesbos, and retained him for a time at his court in Constantinople. At the accession of Valens (364) he retired to his estate at Lesbos, but soon returned to Constantinople, where he died in 367. The Anomoean sect of the Arians, of whom he was leader, are sometimes called after him *Aetians*. His work *De Fide* has been preserved in connection with a refutation written by Epiphanius (*Haer.*, lxxvi. 10).

*See* A. Harnack, *History of Dogma,* vol. iv. *passim.*

**AETIUS** (died 454), a Roman general of the closing period of the Western empire, born at Dorostolus in Moesia, late in the 4th century. He was the son of Gaudentius, who, although possibly of barbarian family, rose in the service of the Western empire to be master of the horse, and later, count of Africa. Aetius passed some years as hostage, first with Alaric and the Goths, and later in the camp of Rhuas, king of the Huns, acquiring in this way the knowledge which enabled him afterwards to defeat them In 424 he led into Italy an army of 60,000 barbarians, mostly Huns, which he employed first to support the *primicerius* Ioannes, who had proclaimed himself emperor, and, on the defeat of the latter, to enforce his claim to the supreme command of the army in Gaul upon Placidia, the empress-mother and regent for Valentinian III His calumnies against his rival, Count Boniface, which were at first believed by the emperor, led Boniface to revolt and call the Vandals to Africa. Upon the discovery of the truth, Boniface, although defeated in Africa, was received into favour by Valentinian; but Aetius came down against Boniface from his Gallic wars, and in the battle which followed wounded Boniface fatally with his own javelin. From 433 to 450 Aetius was the dominating personality in the Western empire. In Gaul he won his military reputation, upholding for nearly 20 years, by combined policy and daring, the falling fortunes of the empire. His greatest victory was that of Châlons-sur-Marne (Sept. 20, 451), in which he led the Gallic forces against Attila and the Huns. This was the last triumph of the empire. Three years later (454) Aetius presented himself at court to claim the emperor's daughter in marriage for his son Gaudentius; but Valentinian, suspecting him of designs upon the crown, slew him with his own hand.

"That he was the one prop and stay of the Western empire during his life is the unanimous verdict of his contemporaries; but whether he was a really great general or statesman we cannot tell. He was beaten by Boniface; and it was not he, but the Goths and their king, who really triumphed in the Mauriac plain; yet he recovered Gaul in a series of campaigns, and he kept the Visigoths in check. . . . If he was less Roman than his predecessor Constantius, he was far more Roman than his successor Ricimer; and if he had occasionally used the arms of the Huns for his own ends, he had also used them to maintain the empire. One merit he had which must count for much—the merit of recognizing and encouraging men of ability. Majorian and Marcellinus, two of the finest figures in the history of the fallen empire, were men of his training." (Ernest Barker in *Cambridge Mediaeval Hist.*, vol. i., I., 418–419.)

*See* T. Hodgkin, *Italy and her Invaders,* vols. i. and ii. (1880).

**AETIUS,** a Greek physician, born at Amida in Mesopotamia, flourished at the beginning of the 6th century A.D. He was court physician at Byzantium. He wrote a large medical work in 16 books, founded on Oribasius and compiled from various sources, especially Galen (Galenos). Eight books of the Greek original were printed in Venice in 1534, and a complete Latin translation by Cornarius at Basel, 1542.

*See* Weigel, *Aetianarum exercitationum specimen* (1791); Danelius, *Beitrag zur Augenheilkunde des Aetius* (1889), Zernos, *Aetii sermo sextidecimus et ultimus*, editio princeps (1901), T C. Allbutt, *Greek Medicine in Rome* (1921); M. Neuberger, *History of Medicine*, vol. i (1910)

**AETNA,** a Latin hexameter poem of 644 lines ascribed by the mss. to Virgil. This ascription is now universally rejected, but it is obvious that the author was an imitator of Virgil who was familiar with the Aeneid as well as the Bucolics and Georgics, and therefore lived at least as late as the time of Augustus. As there is no mention of the eruption of Vesuvius which destroyed Pompeii and Herculaneum it is safe to presume that the work was composed before A D. 79. The poem has been attributed by various authorities to Claudian, Cornelius Severus and Manilius, but modern opinion assigns it to Lucilius Junior, the friend of Seneca, whose interest in, and knowledge of scientific matters is alluded to in the philosopher's correspondence He is known to have been a governor of Sicily and to have written poems *Aetna* discusses the possible explanation of the volcano's action

Text edited (1920) by Robinson Ellis in J. P. Postgate's *Corpus Poetarum Latinorum.*

**AETOLIA,** a district of northern Greece, bounded on the south by the Corinthian Gulf, on the west by the river Achelous, on the north and east by the western spurs of Parnassus and Oeta The land naturally falls into two divisions. The basins of the lower Achelous (mod. *Aspropotamo*) and Euenus (*Phidharis*) form a series of alluvial valleys intersected by detached ridges which mostly run parallel to the coast. This district of "Old Aetolia" lacks a suitable sea-board, but the inland, and especially the plain of central Aetolia lying to the north of Lakes Hyria and Trichonis and Mount Aracynthus, forms a rich agricultural country. The northern and eastern regions are broken by an extensive complex of chains and peaks, whose rugged limestone flanks are clad at most with stunted shrubs and barely leave room for a few precarious mule-tracks. These heights often rise in the frontier-ranges of Tymphrestus, Oxia and Corax to more than 7,000 ft.; the snow-capped pinnacle of Kiona attains to 8,240 ft. A few defiles pass through this barrier to the other side of the north Greek watershed.

In early legend Old Aetolia, with its cities of Pleuron and Calydon, figures prominently. During the great migrations (*see* DORIANS) the population was largely displaced, and the old inhabitants long remained in a backward condition. In the 5th century some tribes were still living in open villages under petty kings, addicted to plunder and piracy, and hardly recognized as Hellenes at all. Yet their military strength was not to be despised: in 426 their archers and slingers easily repelled an Athenian invasion under Demosthenes. In the 4th century the Aetolians began to take a greater part in Greek politics, and, in return for helping Epameinondas (367) and Philip of Macedon (338), recovered control of their sea-board, to which they annexed the Acarnanian coast and the Oeniadae. Aetolia's prosperity dates from the period of Macedonian supremacy. It may be ascribed partly to the wealth and influence acquired by Aetolian mercenaries in Hellenistic courts, but chiefly to the formation of a national Aetolian league, the first effective institution of this kind in Greece. Created originally to meet the peril of an invasion by the Macedonian regents Antipater and Craterus, who had undertaken a punitive expedition against Aetolia after the Lamian War (322), and by Cassander (314–311), the confederacy grew rapidly during the subsequent period of Macedonian weakness. Since 290 it had extended its power over all the uplands of central Greece, where its command over Heracleia (280) provided it with an important defensive position against northern invaders, its control of Delphi and the Amphictyonic council with a useful political instrument. The valour of the Aetolians was conspicuously displayed in 279, when they broke the strength of the Celtic irruption by slaughtering great hordes of marauders. The commemorative festival of the Soteria, which the league established at Delphi, obtained recognition from many leading Greek states. After annexing Boeotia (by 245) the Aetolians controlled all central Greece. Endeavouring next to expand into Peloponnesus, they allied themselves with Antigonus Gonatas of Macedonia against the Achaean league (*q.v.*), and besides becoming protectors of Elis and Messenia won several Arcadian cities. Their naval power extended to Cephalonia, to the Aegaean islands and even to the Hellespont. The league at its zenith had thus a truly imperial status.

Later in the century its power began to be sapped by Macedonia To check King Demetrius (239–229) the Aetolians joined arms with the Achaeans. In 224 they held Heracleia Trachis against Antigonus Doson, but lost control of Boeotia and Phocis Since 228 their Arcadian possessions had been abandoned to Sparta. At the same time a new enemy arose in the Illyrian pirate fleets, which outdid them in unscrupulousness and violence. The raids of two Aetolian chiefs in Achaean territory (220) led to a coalition between Achaea and Philip V of Macedon, who assailed the invaders with great energy, driving them out of Peloponnesus and marching into Aetolia itself, where he surprised and sacked the federal capital Thermon. After buying peace by the cession of Acarnania (217) the league concluded a compact with Rome. In the great war of their Roman allies against Philip the federal troops took a prominent part, their cavalry being largely responsible for the victory of Cynoscephalae (197). The Romans in return restored central Greece to the league, but by withholding its former Thessalian possessions excited its deep resentment. The Aetolians now invited Antiochus III. of Syria to European Greece, and so precipitated a conflict with Rome. But in the war they threw away their chances. In 192 they wasted themselves in an unsuccessful attempt to secure Sparta. In 191 they supported Antiochus badly, and by their slackness in the defence of Thermopylae made his position in Greece untenable. Having thus isolated themselves the Aetolians stood at bay behind their walls against the Romans, who refused all compromises, and, after the general surrender in 189, restricted the league to Aetolia proper and assumed control over its foreign relations. By the time of Sulla, the functions of the Aetolian league had become purely nominal. The federal constitution closely resembled that of the Achaean league, for which it doubtless served as a model. The general assembly, convoked every autumn at Thermon to elect officials, and at other places in special emergencies, shaped the league's general policy; it was nominally open to all freemen, though no doubt the Aetolian chieftains really controlled it. The council of deputies from the confederate cities undertook the routine of administration and jurisdiction. The *strategus* (general), aided by 30 *apocleti* (ministers), had complete control in the field and presided over the assembly, though with restricted advisory powers. The Aetolians also used the Amphictyonic synod for passing solemn enactments. The league's relation to outlying dependencies is obscure; many of these were probably mere protectorates or "allied states" and secured no representation. The federal executive was certainly much more efficient than that of the Achaeans, and its councils suffered less from disunion; but its generals and admirals, official or otherwise, enjoyed undue licence; hence the league deservedly gained an evil name for the numerous acts of lawlessness or violence which its troops committed. But as a champion of republican Greece against foreign enemies no other power of the age rendered equal services. In the 15th century Aetolia passed under the rule of Scanderbeg and the Venetians, but was finally conquered for the Turks by Mohammed II. In the War of Independence it was the scene of severe fighting, including the sieges of Missolonghi.

(M. C.)

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**AFARS** (DANAKIL), a tribe of African "Arabs" of Hamitic stock. They occupy the arid coast-lands between Abyssinia and the sea. They claim to be Arabs, but are more akin to the Galla and Somali. The tribe is roughly divisible into a pastoral and a

coast-dwelling group. Their religion is chiefly fetich and tree-worship; many, nominally, profess Mohammedanism They are distinguished by narrow straight noses, thin lips and small pointed chins. They wear, generally, nothing but a waist-cloth They are divided into many sub-tribes, each having an hereditary sultan.

*See* Fr. Scazamucci and E H. Giglioli, *Notizie sui Danakil* (1884); P. Paulitschke, *Ethnographie Nordost-Afrikas* (2 vols, Berlin, 1893–1896), and *Die geographische Erforschung der Adâl-Länder und Harâr's in C* [illegible] 1884).

**AFER, DOMITIUS,** a Roman orator and advocate, was born at Nemausus (Nîmes). He became an informer and gained the favour of Tiberius by accusing Claudia Pulcra, a cousin of Agrippina, of treason. He was consul under Caligula (39) and superintendent of the water supply under Nero. He died in A.D. 60. His pupil, Quintilian, who calls him the greatest orator he had ever known, quotes some of his witty sayings (*dicta*), collections of which were published, and mentions two books by him *On Witnesses*.

*See* Quintilian, *Instit.* vi. 3. 42, viii. 5. 16, x. 1 118, etc.; Tac *Ann.* iv. 52, 68, xiv. 19; Dio Cassius lix. 19, lx. 33; Pliny, *Epp.* ii. 14, viii. 18.

**AFFECTION,** literally, a state resulting generally from an external influence. The term was at one time employed to denote the states even of material bodies, but is now confined to certain *mental* states only, in fact, to certain *feelings*. It is popularly used of a sentiment between persons amounting to more than good will or friendship. By ethical writers the word has been used generally of distinct states of feeling, both lasting and spasmodic; some contrast it with "passion," as being free from the distinctively sensual element. More specifically the word has been restricted to emotional states which are in relation to persons. In the former sense, it is the Gr. *πάθος*, and as such it appears in Descartes and most of the early British ethical writers. On various grounds, however—*e.g.*, that it does not involve anxiety or excitement, that it is comparatively inert and compatible with the entire absence of the sensuous element—it is generally and usefully distinguished from passion. In this narrower sense the word has played a great part in ethical systems, which have spoken of the social or parental "affections" as in some sense a part of moral obligation. For a consideration of these and similar problems, which depend ultimately on the degree in which the affections are regarded as voluntary, *see* H. Sidgwick, *Methods of Ethics*, pp. 345–349.

In psychology the terms "affection" and "affective" are used for the characteristic quality of experiences that are neither cognitive nor conational. As all intellectual phenomena have by some psychologists been reduced to sensation, so all feeling has been regarded as reducible to simple mental affection, the element of which all emotional manifestations are ultimately composed. The nature of this element is a problem which has been provisionally, but not conclusively, solved by many psychologists; the method is necessarily experimental, and all experiments on feeling are peculiarly difficult. The solutions proposed are two. In the first, all affective phenomena are primarily divisible into those which are pleasurable and those which are the reverse. The main objections to this are that it does not explain the infinite variety of phenomena, and that it disregards the distinction which most philosophers admit between higher and lower pleasures. The second solution is that every sensation has its specific affective quality, though by reason of the poverty of language many of these have no name. W. Wundt, *Outlines of Psychology* (trans. C. H. Judd, Leipzig, 1897), maintains that we may group under three main affective directions, each with its negative, all the infinite varieties in question; these are (a) pleasure, or rather pleasantness, and the reverse, (b) tension and relaxation, (c) excitement and depression.

Two methods of experiment have been tried. The first, introduced by A. Mosso, the Italian psychologist, consists in recording the physical phenomena which are observed to accompany modifications of the affective consciousness. Thus it is found that the action of the heart is accelerated by pleasant, and retarded by unpleasant, stimuli; again, changes of weight are found to accompany modifications of affection—and so on.

The second is Fechner's method; it consists in recording the changes in feeling-tone produced in a subject by bringing him in contact with a series of conditions, objects or stimuli graduated according to a scientific plan and presented singly, in pairs or in groups. The result is a comparative table of likes and dislikes.

(*See* FEELING)

**AFFETTUOSO** (Ital.), a musical direction signifying that the composition or particular passage so marked is to be played with much expression and feeling *Espressivo* and *con espressione* are other terms having much the same significance.

**AFFIDAVIT,** a written statement sworn or affirmed to before some person who has authority to administer an oath or affirmation. Evidence is chiefly taken by means of affidavits in the chancery division of the High Court of Justice in England on a petition, summons or motion. Interlocutory proceedings before trial are conducted by affidavits, *e.g.*, for discovery of documents, hence called *affidavit of documents*. Affidavits are sometimes necessary as proof that certain legal formalities have been duly and legally performed. On special application to the court a deponent may be cross-examined on the statements contained in his affidavit. In Scotland the testimony of witnesses by affidavit is almost unknown, except in proceedings in the Sheriff Court of Chancery, and petitions for the sequestration of bankruptcy, where affidavits are enjoined by statute. In the rules of the Supreme Court (R.S.C. Ord. XXXVIII.) certain formal requirements are laid down for all affidavits and affirmations in causes or matters depending in the High Court. An affidavit must consist of title, body or statement and jurat. It must be written or printed on foolscap, bookwise, in the first person; give correctly the names of the parties to the action; and the description and true place of abode of the deponent. An affidavit is confined, except on interlocutory motions, to such facts as the witness is able of his own knowledge to prove. The signature of the deponent must be written opposite to the jurat, which must contain the place, date and time of swearing, and this signed by the officer or magistrate before whom the affidavit is sworn. An affidavit sworn on a Sunday is not invalid. Quakers, Moravians and Separatists were first privileged to make a solemn declaration or affirmation, and by the Common Law Procedure Act, 1852, and other statutes all persons prevented by religious belief from taking an oath were allowed to affirm; and, finally, by the Oaths Act, 1888, every person who objects to be sworn is allowed to affirm in all places and for all purposes where an oath is required by law. By an act of 1835 justices are permitted to take affidavits in any matter by declaration, and a person making a false affidavit in this way is liable to punishment. The same act prohibited justices of peace from administering oaths in any matter in which they had not jurisdiction as judges, except when an oath was specially authorized by statute, as in the bankruptcy law, and excepting criminal inquiries, parliamentary proceedings and instances where oaths are required to give validity to documents abroad. Scottish justices can act in England and *vice versa*. The Oaths Act, 1888, and the Commissioner of Oaths Act, 1889, consolidated all previous enactments relating to oaths and gave the lord chancellor power to appoint commissioners for oaths to take affidavits for all purposes (*see* OATH).

In the United States affidavit has the same meaning as in England and its general uses are the same, but it is not substituted for oral evidence in court to anything like the extent to which that is done in the English courts of chancery. The statutes of each State designate the persons before whom affidavits may be made outside the State, and special commissioners are appointed for that purpose by each State. Affidavits made abroad must be made before such commissioners or persons so designated, who are usually diplomatic and consular officials, justices, notaries public or mayors.

**AFFILIATION,** in law, the procedure by which the paternity of a bastard child is determined, and the obligation of contributing to its support enforced. In England a number of statutes on the subject have been passed, the chief being the Bastardy Act of 1845, the Bastardy Laws Amendment Acts of 1872 and 1873, the

Affiliation Orders Act, 1914, the Affiliation Orders Act, 1918, and the Bastardy Act, 1923. The mother of a bastard may summon the putative father to petty sessions within 12 months of the birth (or at any later time if he is proved to have contributed to the child's support or ceased to reside in England within 12 months after the birth), and the justices, after hearing evidence on both sides, may, if the mother's evidence be corroborated in some material particular, adjudge the man to be the putative father of the child, and order him to pay a sum not exceeding 20 shillings a week for its maintenance, together with a sum for expenses incidental to the birth, or the funeral expenses, if it has died before the date of order, and the costs of the proceedings An order ceases to be valid after the child reaches the age of 13, except as regards arrears, but the justices may in the order direct the payments to be continued until the child is 16 years of age An appeal to quarter sessions is open to both the mother and the defendant, and a further appeal on questions of law to the King's Bench. Should the child afterwards become chargeable to the parish, the sum due by the father may be received by the relieving officer. When a bastard child whose mother has not obtained an order, becomes chargeable to the parish, the guardians may proceed against the putative father for a contribution, and such an order may be varied and continued in favour of the mother or person having custody of the child. Any woman who is single, a widow, or a married woman living apart from her husband, may make an application for a summons. The Bastardy Act, 1872, makes due provision for the enforcement of an order of affiliation, and commitment is governed by the Summary Jurisdiction Act, 1879, and the Criminal Justice Act, 1914. In the case of soldiers an affiliation order cannot be enforced in the usual way, but by the Army Act 1881, as amended in 1883, 1891, 1904 and 1915, if an order has been made against a soldier of the regular forces, a portion of the soldier's pay may be retained There is similar legislation with regard to sailors in the Royal Navy, by the Naval Discipline Act, 1915.

It having been found in practice that affiliation orders became ineffective owing to the unwillingness or inability of the mother to make continual appearances before the justices, under the Affiliation Orders Act, 1914, collecting officers may be appointed

In the United States the father is primarily responsible for the support of a bastard child. The mother is responsible in the event of the father's death.

In the British colonies there is some procedure (usually termed filiation) akin to that described above, by means of which a mother can obtain a contribution to the support of her illegitimate child from the putative father. On the continent of Europe, however, the legislation of the various countries differs rather widely. (*See* ADOPTION; also BASTARD; POOR LAW.)

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**AFFINE GEOMETRY.** An affine geometry, as distinguished from a projective geometry, involves a definition of parallelism. Thus, when from the definitions and theorems of the ordinary euclidean geometry of the plane all those involving euclidean measurement of length and angle are eliminated, the residue is an affine geometry. In this case the line at infinity is unique, in that any two lines meeting in a point of the former are parallel. In the projective geometry of the plane there is no such preferred line; when any line is designated as preferred in this sense, we have a corresponding affine geometry. For example, in affine geometry there is a distinction between an ellipse, a parabola and a hyperbola, but not in projective geometry; moreover, only when the geometry is metrical is there a distinction between circles and ellipses.

The euclidean affine geometry is given analytic form by means of coordinates $x$ and $y$ referred to two intersecting lines of the plane in the usual manner. In this case the equations

$$\begin{aligned} x_1 &= a_{11}x + a_{12}y + a_1, \\ y_1 &= a_{21}x + a_{22}y + a_2, \end{aligned} \tag{1}$$

where the $a$'s are arbitrary constants subject to the condition $a_{11}a_{22} - a_{12}a_{21} \neq 0$, define the most general transformation of points of the plane among themselves which transforms parallel lines into parallel lines. Such a transformation is called *affine*. The transformations (1) form a group, and we may say, following Klein, that the body of definitions and theorems expressing properties of quantities invariant under this group is an affine geometry. If $x', y'$, $x'', y''$; $x''', y'''$ are the coordinates of three non-collinear points, the quantity

$$\begin{vmatrix} x' & y' & 1 \\ x'' & y'' & 1 \\ x''' & y''' & 1 \end{vmatrix} \tag{2}$$

is invariant under transformations (1) for which $a_{11}a_{22} - a_{12}a_{21} = 1$. These transformations are called *equiaffine*. There is a considerable body of theorems concerning properties of plane curves which remain invariant under equiaffine transformations. In particular, there is a metric theory based upon a certain invariant of the type (2) associated with a curve.

The foregoing concepts are readily generalized to spaces of higher order. Thus there is for spaces of three dimensions a theory of curves and surfaces analogous in many respects to the theory for euclidean space of three dimensions. The developments of these ideas have been made by many geometers, notably Klein, Mobius, Sylvester and lately by Blaschke and Pick.

Any $n$ independent variables $x_i$, where $i$ takes the values 1 to $n$, may be thought of as the coordinates of a general $n$-dimensional space, or variety, in the sense that each set of values of the $x$'s defines a point. In a space thus defined there is not a basis for the comparison of directions at different points. Such a basis is provided when a definition of parallelism is added. In Riemannian geometry we say, following Levi-Cività, that at points of a curve, defined by $x_i = f_i(t)$, $(i = 1, \cdots, n)$, a set of functions $\xi^i$ of $t$ satisfying the system of equations

$$\begin{aligned} &\xi^i\left(\frac{d\xi^i}{dt} + \sum_{k,l}^{1,\cdots,n} \Gamma^i_{kl}\,\xi^k \frac{dx_l}{dt}\right) \\ &-\xi^j\left(\frac{d\xi^i}{dt} + \sum_{k,l}^{1,\cdots,n} \Gamma^i_{kl}\,\xi^k \frac{dx_l}{dt}\right) = 0 \quad (i, j = 1, \cdots, n) \end{aligned} \tag{3}$$

are the components of a family of vectors parallel with respect to the curve; in this case $\Gamma^i_{jk}$ are functions of the $x$'s determined by the metric of the space (*see* RIEMANNIAN GEOMETRY). As thus defined, parallelism is relative to a curve, and not absolute, as in euclidean space. If the $\Gamma$'s in (3) are taken as $n^3$ arbitrary functions of the $x$'s, equations (3) may be taken as the definition of parallelism for a general $V_n$, thus generalizing Levi-Cività's concept of parallelism for spaces with a Riemannian metric. In this case we say that the space is *affinely connected*, following Weyl; the $\Gamma$'s are called the coefficients of the affine connection.

When $\Gamma^i_{jk} = \Gamma^i_{kj}$, the connection is called *symmetric*, otherwise *asymmetric*. When, and only when, the connection is symmetric, there exist preferred coordinate systems, with a given point as origin, with respect to which corresponding components of a vector at the given point and of a parallel one at a nearby point are the same. When the connection is asymmetric, there are other connections giving an equivalent definition of parallelism; the definition is unique for symmetric connections.

The fundamental curves of an affinely connected space are those whose tangents are parallel with respect to the curves; *i.e.*, they are the straight lines of the space. They are the integral curves of the differential equations obtained when $\xi^i = dx_i/dt$ in (3). Some writers call them the *paths* of the space, others *geodesics*, since they are the generalizations of the geodesics of Riemannian spaces. There are many affine connections with the same paths, so that the theorems dealing with the paths and not with a particular affine connection constitute a projective geometry. A theory of affinely connected spaces, in many respects analogous to Riemannian geometry, has been developed recently, notably by Cartan, Eddington, Einstein, Schouten, Joseph M. Thomas, Tracy Y. Thomas, Veblen and Weyl.

BIBLIOGRAPHY.—O. Veblen, *Projective Geometry*, vol. ii. (Boston, 1918); H. Weyl, *Space, Time, Matter* (1922); W. Blaschke, *Vorles-*

*sungen über Differential Geometrie,* vol ii. (1923); J. A. Schouten, *Der* [illegible]; L. P. Eisenhart, "Non-Riemannian Geometry," *American Mathematical Society* (1927); O. Veblen, "Invariants of Quadratic Differential Forms," *Cambridge Tracts in Mathematics* (1927). (L. P. E.)

**AFFINITY,** in law, as distinguished from consanguinity (*q.v.*), the term applied to the relation which each party to a marriage, the husband and wife, bears to the kindred of the other. Affinity is usually described as of three kinds: (1) *direct,* that relationship which subsists between the husband and his wife's relations by blood or between the wife and the husband's relations by blood. The marriage having made them one person, the blood relations of each are held as related by affinity in the same degree to the one spouse as by consanguinity to the other. But the relation is only with the married parties themselves, and does not bring those in affinity with them in affinity with each other; so a wife's sister has no affinity to her husband's brother. This is (2) *secondary* affinity. (3) *Collateral* affinity is the relationship subsisting between the husband and the relations of his wife's relations.

The subject is chiefly important from the matrimonial prohibitions by which the canon law has restricted relations by affinity. Taking the table of degrees within which marriage is prohibited because of consanguinity, the rule has been thus extended to affinity, so that wherever relationship to a man himself would be a bar to marriage, relationship to his deceased wife will be the same bar, and *vice versa* on the husband's decease.

Briefly, *direct* affinity is a bar to marriage. This rule has been founded chiefly on interpretations of the eighteenth chapter of Leviticus. Formerly by law in England, marriages within the degrees of affinity were not absolutely null, but they were liable to be annulled by ecclesiastical process during the lives of both parties; in other words, the incapacity was only a canonical, not a civil, disability. By the Marriage Act of 1835 all marriages of this kind not disputed before the passing of the act were declared absolutely valid, while all subsequent to it were declared null. This rendered null in England, and not merely voidable, a marriage with a deceased wife's sister or niece. (*See* MARRIAGE.)

**AFFINITY, CHEMICAL,** the property or relation in virtue of which substances are capable of entering into chemical combination with each other. (*See* CHEMISTRY; VALENCY.)

**AFFIRMATION,** the declaration that something is true; in logic, a positive judgment, the union of the subject and predicate of a proposition; particularly, in law, the solemn declaration allowed to those who conscientiously object to taking an oath.

**AFFORESTATION:** *see* FORESTS AND FORESTRY.

**AFFRAY** is the misdemeanour of breaking the peace in public to the terror of the king's subjects. Fighting in public is an affray, but no actual violence is necessary, and the offense is committed even where a man arms himself with weapons so as to cause terror to the public. Abusive and threatening words alone will not amount to an affray. In 1903 at the Carnarvon assizes before Justice Wills a conviction was obtained in *Rex* v. *Meade* where the accused went about armed and discharged a loaded revolver in a public street. He was also indicted under a statute of 1328 (2 Edw. III *c.* 3). (*See* also RIOT.)

In the United States the English common law as to affray applies, subject to certain modifications by the statutes of particular states (Bishop, *Amer. Crim. Law,* 9th ed., 1923, vol. i, § 535). The Indian penal code (§159) adopts the English definition of affray, with the substitution of "actual disturbance of the peace" for "causing terror to the lieges."

**AFFRE, DENIS AUGUSTE** (1793–1848), archbishop of Paris, was born at Saint-Rome-de-Tarn, on Sept. 27, 1793. He was educated for the priesthood at St. Sulpice, where in 1818 he became professor of dogmatic theology. After filling a number of ecclesiastical offices, he was elevated to the archbishopric of Paris in 1840. Though opposed to the government of Louis Philippe, he took no part in politics, but devoted himself to his pastoral work. His episcopate is chiefly remembered for its tragic close. During the riots of June 23 to 26, 1848, the archbishop was led to believe that by his personal interference peace might be restored between the soldiers and the insurgents. Accordingly, in spite of the warning of General Cavaignac, he mounted the barricade at the entrance to the Faubourg St. Antoine, bearing a green branch as a sign of peace. He had spoken only a few words, however, when the insurgents, hearing shots and believing they were betrayed, opened fire on the soldiers, and the archbishop was struck by a stray bullet. He died on June 27, 1848, and the following day the national assembly issued a decree expressing their sorrow because of his death. The public funeral held on July 7 was, it is said, one of the most striking spectacles of its kind. The archbishop wrote several treatises of considerable value, including an *Essai sur les hieroglyphes egyptiens* (Paris, 1834).

*See* Ricard, *Les grands evêques de l'église de France au XIX^e siècle* (Lille, 1893); L. [illegible], *Denis-Auguste Affre, archeveque de Paris* (Paris, 1905).

**AFFREIGHTMENT.** Payment for the carriage of goods by water, more especially by sea, is called freight, and a bargain made between the carrier and the person whose goods are to be so carried is called a contract of affreightment. The law does not require that a contract of this kind shall be made in writing, but usually it is expressed in that form. The terms on which goods are carried by sea are, except in coasting trade, ordinarily expressed in a charter-party or a bill of lading or both. The former may be shortly described as a contract between a shipowner and a merchant for the hire or use of a ship, and the latter as a receipt for goods, stating the terms on which they are delivered to and received by a ship. A charter-party usually relates to the full cargo of a ship, and a bill of lading may do the same, but it is more often given with reference to a particular parcel of goods.

**Terms Implied by Law.**—The parties to a contract of affreightment are assumed by law (unless the contract expressly negatives or qualifies the assumption) to have dealt with each other on the footing of certain obligations included among the terms of contract. In the unusual case of no terms being expressly agreed, the implied terms alone would regulate the relations of the parties. In the common case of terms being expressly agreed, the implied terms are included, subject to any modification of them specifically and explicitly made by the express terms. It should be mentioned in passing that, where the goods are carried under bills of lading, certain terms are by statute (as explained below) included in the contract which the parties are not free to exclude even if they wish.

Subject then to any modification made by the contract, a person who for payment carries goods by sea is under an implied obligation to exercise due care and diligence. Except possibly in a case where the sea carrier is not a common carrier (*i.e.*, where he does not profess himself ready to carry goods for everybody) he has a further degree of responsibility, in that he is liable for every accident, unless caused by act of God, or of the king's enemies, or by inherent defect of the goods themselves, or by their having been sacrificed for the general safety. He also impliedly undertakes absolutely that the ship is seaworthy at the beginning of the voyage, and that he will proceed on the voyage with reasonable dispatch, and without unnecessary deviation. Seaworthy has a special meaning as explained later. The carrier may in some circumstances be entitled to claim statutory limitation of the amount of his liability.

On the part of the shipper an undertaking is implied not to ship dangerous goods without notice, and he or the person entitled to take delivery of the goods is impliedly under obligation (1) to be prepared, without notice from the carrier, to take delivery within a reasonable time after the arrival of the ship at the place of delivery, and (2) to pay freight and general average contribution (if any) before he can claim delivery of the goods. In some circumstances where performance of the contract becomes impossible the parties may be released from performance under terms deemed to be implied in the contract.

**Parties to the Contract.**—As already mentioned, the terms of contract are ordinarily expressed in a charter-party (shortly, a charter) or a bill of lading, or both. A bill of lading may be more fully described as "a receipt for goods shipped on board a

ship, signed by the person who contracts to carry them, or his agent, and stating the terms on which the goods were delivered to and received by the ship. It is not the contract, for that has been made before the bill of lading was signed and delivered, but it is excellent evidence of the terms of the contract" (Scrutton). Usually the printed form of the particular carrier is filled up in writing and signed by the captain, broker or other agent of the carrier, and the terms of the contract made or deemed to have been made before the bill of lading was given are thus reduced to documentary form. Though in form a receipt, a bill of lading is also a transferable document of title representing the goods to which it relates.

Where the contract is between a shipper and a carrier who is himself the shipowner the bill of lading binds the shipowner. In the case of a chartered ship—*i e.*, a ship hired by a charterer—the bill of lading may, according to the circumstances, bind the shipowner or the charterer. Charters are varied in form. Under some, where the shipowner parts with the whole possession and control of the ship (so that the charter amounts to a demise, a form rare in modern practice) the contract would be between the shipper and the charterer. Under other charters the charterer may merely undertake that a full cargo shall be shipped and guarantee payment of a certain freight. There the contract would be between shipper and shipowner. Where, in intermediate cases, the shipper is a person other than the charterer, the bill of lading may, according to the terms of the charter, bind the shipowner or the charterer.

**Charter-parties.**—Charters (apart from the unusual form amounting to a demise of the ship) are entered into for a voyage (or series of voyages) or for a period of time. A voyage charter commonly provides that the ship, as described, shall proceed to a named place, and there load a cargo, and shall then proceed to a named place of discharge, where the cargo is to be delivered. Freight is to be paid in a lump sum, or at a rate named on the cargo carried, or calculated in some other way. The number of days within which the charterers are to load and discharge (called lay days) is specified, and also a rate for demurrage should the ship be longer detained, with provisions to apply in the event of stoppages occurring. "Days" in a charter is understood to mean calendar days of 24 hours commencing at midnight. Sundays and holidays are included unless expressly excepted. "Working days" means all days on which work is ordinarily done at the port, excluding Sundays and holidays. Provisions as to time are frequently expressed in hours instead of days. Further clauses deal with issue of bills of lading, exceptions from liability, discharge of cargo, payment of freight, general average, ceasing of charterer's liability, brokerage, etc.

By a time charter the ship is hired to the charterers for a specified time, commencing on a certain date, when the ship is to be placed at the disposal of the charterers, at some specified place, or place to be named, to be employed in lawful trades between certain limits. The clauses deal with various matters in connection with the employment of the ship, such as payments for stores, provisions, wages, insurance, fuel, port and other charges, the appointment and giving of directions to the master of the ship, stevedoring, exceptions from shipowner's liability, arbitration, etc. A number of common forms of charter are in use containing clauses adjusted to the requirements and conditions of particular trades.

In determining the effect to be given to a charter it may be necessary to take into consideration along with its express terms other terms which, as already explained, are implied by law. Thus if a charter contains no express provision as to seaworthiness there is underlying the contract, and implied and involved in it, a warranty by the shipowner that the ship is seaworthy. The special meaning attached to this word is that the ship shall have that degree of fitness which an ordinarily careful and prudent owner would require his ship to have at the commencement of her voyage, having regard to all the probable circumstances of it. Not only must the ship be tight, staunch and strong, but also fit for the carriage of the particular kind of cargo to be carried. This implied absolute warranty of seaworthiness is fulfilled if the ship is seaworthy when she leaves her moorings, and does not include any undertaking that the ship shall continue seaworthy; but where the voyage is in stages the ship must be fit for each stage when entered upon.

There may also have to be taken into consideration, in construing a charter, trade usages or customs with reference to which the parties are presumed to have made their contract. The express terms often refer to custom (which in a charter means a settled and established practice of the port), and they may be explained by evidence of usage or custom short of alleging anything inconsistent with them. For example, stipulations as to loading or discharging cargo in a port may be thus construed Evidence of custom may be given to explain the meaning of working day at the port.

When a ship has reached the place (under a voyage charter) she is to be ready to load, and is ready to load, and the charterers have been notified of this, the ship is an arrived ship and the lay days (for loading) begin to run.

Subject to any express or implied qualification, a charterer undertakes absolutely to furnish a cargo. When he fails to furnish a full cargo the damages which the shipowner is entitled to recover for this breach of contract are called dead freight. It is the duty of the master of the ship on behalf of the owner to receive and properly stow on board the cargo to be carried, which ordinarily is to be delivered to him alongside, but this duty may be subject to modification by custom or contract.

Should a ship be detained beyond the lay days the charterer will become liable to pay for the detention. If the basis for payment has been agreed by the charter the payment is known as demurrage. If it has not been agreed or if the charter refers to a fixed number of demurrage days which has been exceeded, then the payment, or part of it, will be damages for detention, the rate of which may have to be ascertained and may be different from the demurrage rate.

A common provision in a charter is the cesser clause, which is to the effect that the charterer's liability shall cease on the shipment of the cargo to the extent to which the charter gives the shipowner a lien. Under common law the shipowner's lien on the cargo is in respect only of freight and general average contributions. The cesser clause ordinarily confirms this, and gives a lien for demurrage, and sometimes also for dead freight.

**Bills of Lading.**—Though either a charter or a bill of lading or both together may express the terms of a contract, the transactions in which no bill of lading is issued are few, because the bill of lading, in addition to its primary purpose of expressing terms of contract, serves in commerce as a transferable document of title representing the goods to which it relates. Where the charterer is also the shipper, the bill of lading, as between shipowner and charterer, is regarded as no more than a receipt which does not alter the contract contained in the charter. It is merely a receipt until used by the charterer as a transferable document of title, *i.e.*, until negotiated. Where the shipper is a person other than the charterer, the bill of lading is the evidence of the contract and does not, except by plain words incorporate or impose on the shipper the obligations of the charter. Where the shipper (whether he is the charterer or not) has indorsed the bill of lading to a holder for value, the bill of lading is the only evidence of the contract.

Apart from statutory limitations on freedom of contract presently to be referred to, a common form of bill of lading (as set out in Carver, *Carriage of Goods by Sea*), was as follows:—

"Shipped, in good order and condition, by....., in and upon the good ship called the ....., whereof.....is master for this present voyage, now riding at anchor in the port of ....., and bound for ..... (*description of goods*) marked and numbered as in the margin, and are to be delivered in the like good order and condition at ..... aforesaid (the act of God, the king's enemies, fire, and all and every other dangers and accidents of the seas, rivers, and navigation of whatever nature and kind soever excepted), unto ....., or

to his assigns, he or they paying freight for the said goods at the rate of . . , with primage and average accustomed In witness whereof, the master or agent of the said ship hath affirmed to bills of lading, all of this tenor and date, the one of which bills being accomplished the others to stand void

"Dated in . . the . . day of . . . .

"(Signed) . . . . "

Many "negligence clauses" (exceptions from liability formerly inserted to protect sea carriers) have disappeared from bills of lading as a result of legislation. In the United States the Harter act was passed in 1893. It requires the exercise of due diligence properly to equip the ship and make it seaworthy, and, subject to this being done, gives exemption from navigation risks as distinguished from carrier's risks which the act compulsorily imposes on the carrier by prohibiting the insertion in any bill of lading or shipping document of any clause whereby obligations carefully to handle and stow the cargo and to care for and deliver the same may be lessened, weakened or avoided Similar legislation was afterward passed by some of the British dominions.

More recent legislation has attempted to define by its express terms the liabilities as well as the immunities of the carrier. The Carriage of Goods by Sea act, 1924, was formulated in this way. Scheduled to it is a series of rules which are in effect standard clauses to be deemed part of the terms of bills of lading. This act is applicable to these documents when issued in Great Britain or Northern Ireland. Similar legislation has been passed in Australia, India, most of the British colonies and Belgium.

The Carriage of Goods by Sea act requires that (subject to limited exceptions) the bill of lading shall expressly incorporate as part of its terms the provisions of the rules scheduled to the act. These impose on the carrier an irreducible minimum of responsibility for the safe carriage of the goods.

Though the act thus defines the carrier's liabilities, it does not (except in the case of the implied absolute undertaking to provide a seaworthy ship) expressly exclude the implied obligations referred to above. Though an alternative basis of liability is expressly laid down, the question apparently might arise whether those obligations (other than that of seaworthiness) still exist underlying the contract and implied and involved in it. In any event the compulsory minimum of responsibility is a protection to third persons (such as endorsees) who, though not parties to the contract, may be affected by it, as well as to shippers.

As the rules scheduled to the act become part of the terms of British and Belgian bills of lading they are important, but it is not practicable to give here more than a summary.

Under the definitions in article I "Goods" includes articles of every kind except live animals and deck cargo and "carriage of goods" covers the period from the time when the goods are loaded on to the time when they are discharged from the ship.

By article II the carrier is subject to the responsibilities and liabilities, and entitled to the rights set forth in the rules.

The carrier's responsibilities and liabilities detailed in article III are to exercise due diligence to (1) make the ship seaworthy, (2) properly man, equip and supply the ship, (3) make the holds fit and safe for goods. He must also properly and carefully load, handle, stow, carry, keep, care for and discharge the goods, and issue a bill of lading showing certain particulars of quantity and condition of goods. This document becomes *prima facie* evidence of receipt by the carrier of the goods as therein described. Unless notice of loss or damage is given on delivery (or, if not apparent, within three days) delivery is *prima facie* evidence of delivery and, in any event, carrier is discharged from all liability unless suit is brought within one year. Nothing may be added lessening carrier's liability, but clauses increasing it are allowable, *e.g.*, clause making bill of lading *conclusive* evidence of shipment.

Article IV relieves the carrier from liability for loss or damage resulting from (1) unseaworthiness, unless caused by want of due diligence, (2) a number of specified perils (*e.g.*, act or neglect of the servants of the carrier in the navigation or in the management of the ship, fire, perils of the sea, act of God, etc.) which are mostly perils arising without the actual fault or privity of the carrier. Reasonable deviation is allowed. The carrier is not liable for loss or damage to goods in an amount exceeding £100 per package or unit unless value is declared before shipment and inserted in bill of lading.

Under the form of bill of lading set out above the goods are to be delivered to a named person "or to his assigns." A document in this form is by English law a negotiable instrument, in the sense that it is transferable by indorsement and delivery. A bill of lading may be indorsed by the person named in it (the shipper or the consignee) either in blank, by a simple signature on the back, or specially by indorsing and signing a direction to deliver to some other person or order. The indorsee may then transfer by indorsing in blank or specially If indorsed in blank, or made out to a name left blank, or to bearer, a bill may be dealt with by mere delivery.

The indorsement and delivery of a bill of lading transfers such property as it was the intention of the parties to the indorsement to transfer, and, by the Bills of Lading act, 1855, also transfers to the indorsee, to whom the property in the goods passes, the rights and liabilities of the shipper under the bill of lading. A pledgee is however not an indorsee to whom the property passes, and does not incur liabilities unless he takes delivery of the goods.

**Performance of the Contract.**—Reference has already been made to the implied undertakings by the carrier that he will proceed on the voyage with reasonable dispatch and without unnecessary deviation, and to the doubt whether these obligations still underlie the contract where a bill of lading has been issued subject to the statutory rules.

To complete the voyage the sea carrier should, if necessary, repair the ship, or tranship the cargo in order that it may be forwarded to its destination.

If necessary for the common safety a shipmaster may jettison cargo properly stowed. Any such extraordinary sacrifice or expenditure intentionally and reasonably made or incurred for the common safety, for the purpose of preserving from peril the property involved in a common maritime adventure, is a general average act. Damages, losses and expenses which are the direct consequence of a general average act are borne by ship, freight and cargo as contributing interests. The contributions are adjusted by a general average statement. If, as is commonly the case, the charter or bill of lading incorporates by reference the York-Antwerp rules, 1924, the adjustment is made as provided by those rules. (*See* further as to this under AVERAGE.)

Should the contract prove impossible of performance owing to circumstances which were unforeseen, and to which no provision in the contract is applicable (in particular where circumstances arise from the occurrence of war or in some other way, involving such delay as to frustrate the commercial purpose of the adventure) the contract may be held by the court to have come to an end by virtue of a provision implied in it. Cases of this kind are, of course, quite different from those where the contract, when made, cannot be performed without breaking the law. It is then void from the beginning for illegality.

Under the contract the ship is bound to proceed (unless prevented by an excepted peril) to the agreed place of discharge. On the ship's arrival there the charterer or consignee is bound to take delivery. Unless, under express provision, or by custom, notice of arrival is to be given, none is required. In the case of goods imported from abroad into Great Britain, if the owner of the goods fails to make entry of them at the customs, or to take delivery, the goods may, under and subject to compliance with the provisions of the Merchant Shipping act, 1894, sections 492-501, be landed and warehoused. Delivery should not be made except to a person producing a bill of lading making the goods deliverable to that person. By custom, bills of lading are made out in sets, usually of three copies, but the carrier is justified in delivering to the first person producing a bill of lading making the goods deliverable to him, if without notice or knowledge of anything making it wrong to do so.

If goods are carried to the place where the voyage is to end, and, though damaged, are in a merchantable condition and ready

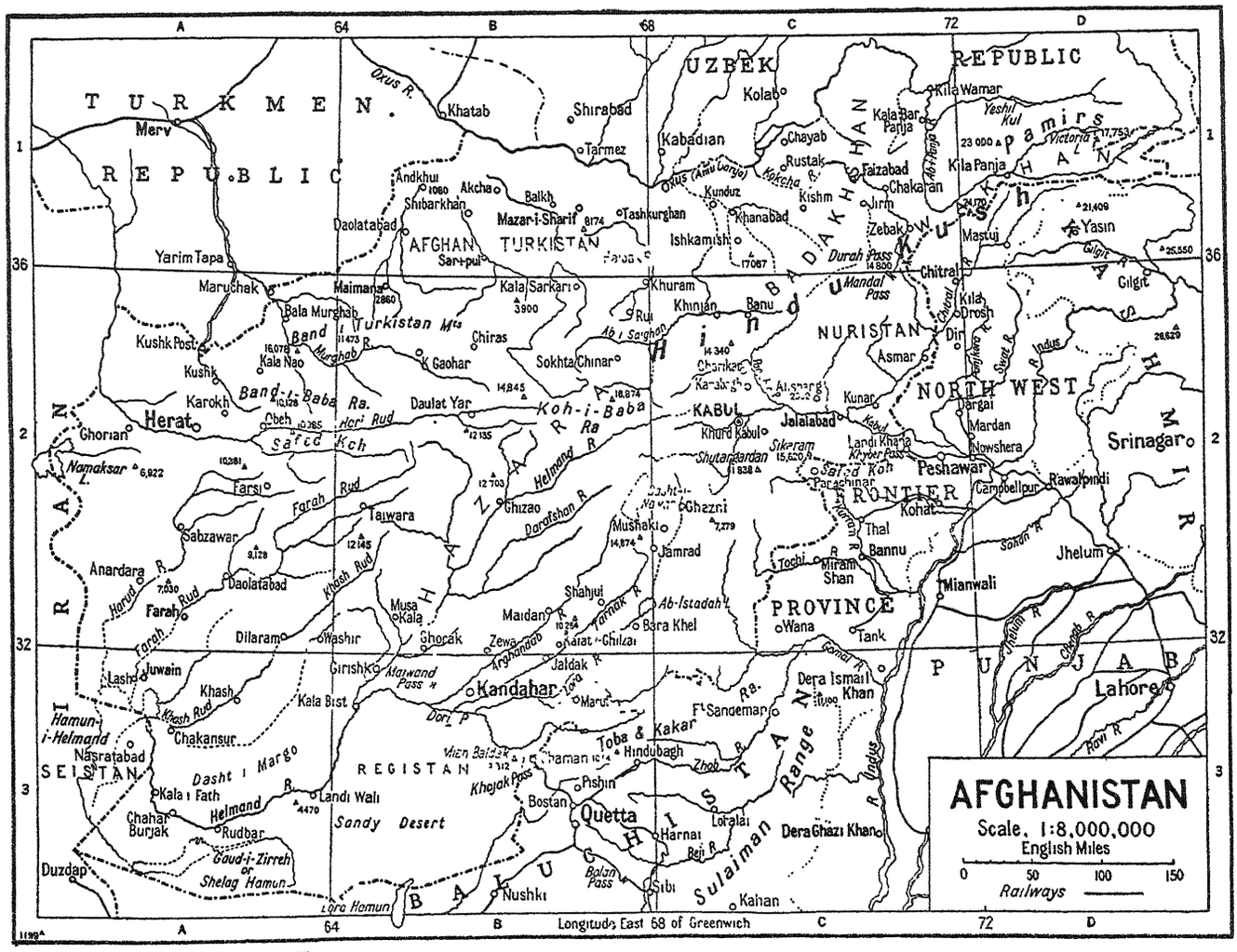
for delivery, freight is payable. For delivery short of destination no freight is due unless the parties have taken steps justifying the conclusion that they intended to make a fresh contract whereby the owner of the goods has agreed to accept the goods at an intermediate port. English law in this respect differs from some continental laws under which proportional distance freight is payable. For short delivery at destination pro rata freight is payable. The carrier is entitled to a lien for freight payable on delivery. This is a possessory lien entitling him to withhold delivery until payment. It extends also to a general average contribution and to expenses incurred in the protection and preservation of the goods. If expressly so provided by the contract, the lien may extend to other matters, *e.g.*, demurrage, damages for detention and dead freight.

*See* T. G. Carver, *Carriage of Goods by Sea* (1925); T. E. Scrutton, *Charter-parties and Bills of Lading* (1925). (S. D. C.)

**AFFRETTANDO** (Ital.), a musical term having just the same significance as *accelerando, i.e.*, a quickening of the *tempo* or speed, but with a suggestion of hurry and agitation in addition.

**AFGHANISTAN**, a country of Asia. Estimated area is 245,000–270,000 sq.mi. Pop. (est. 1938) 7,000,000. It is bounded on the north by Russian Turkistan, on the west by Iran and on the east and south by Chitral and the northwestern provinces of India including Baluchistan. Surveys from 1872 to 1935 delimited this frontier which was accepted by the present (1945) government of Afghanistan. A portion of the southeastern frontier has not been demarcated.

**Boundaries.**—From the town of Zulfikar on the Hari Rud river the boundary between Afghanistan and Russia is roughly parallel to the Paropamisus, and about 35 mi. N of it, till it strikes the Kushk river at Chahil Dukhteran a few miles from the Russian post of Kushk, the terminus of the branch railway from Merv. From Chahil Dukhteran the boundary runs northeast, crossing the Murghab river near Maruchak (an Afghan fortress), and passing through the hills of the Chul, and the undulating deserts of the Aleli Turkmans, to the Oxus (Amu Darya), leaving the valleys of Charshamba and of Andkhui (to which it runs approximately parallel) within Afghan limits. These valleys define the limits of cultivation in this direction. Throughout this region the boundary is generally marked by pillars, but here and there local water partings or watercourses are used. The boundary meets the Oxus at Khamiab at the western extremity of the cultivated district of Khwaja Salar and from that point to the eastern end of Lake Victoria in the Pamirs the Oxus river forms the northern limit of Afghanistan. (*See* Oxus.) Eastward from Lake Victoria the frontier was determined by the Pamir Boundary commission (1895). A part of the little Pamir is Afghan, but the boundary crosses this Pamir before the great bend northward of the Aksu takes place, and passing over a series of crags and untraversable mountain ridges, is lost on the Chinese frontier in the snowfields of Sarikol. Bending back westward the frontier now follows the water parting of the Hindu Kush; and as the Hindu Kush abso-




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**THE LAND OF THE AFGHANS HAS BEEN SUCCESSIVELY, IN ITS LONG AND INTERESTING HISTORY, A CONGERIES OF PETTY STATES, THE CENTRE OF GREAT EMPIRES RULED BY FOREIGNERS AND A DISMEMBERED COUNTRY, FURNISHING PROVINCES TO THREE MONARCHIES. IT IS NOW AN INDEPENDENT SOVEREIGN STATE RULED BY A KING. AS A COUNTRY FROM WHICH THE KHYBER PASS GIVES ADMISSION TO INDIA, AFGHANISTAN HAS ALWAYS POSSESSED A STRATEGIC IMPORTANCE IN EASTERN AFFAIRS**

lutely overhangs the Oxus nearly opposite Ishkashim, it follows that, at this point, Afghanistan is about 10 mi wide. Thus a small high portion of the state extends eastward from its northeastern corner and is attached to the great Afghan quadrilateral by the thin link of the Panja valley. These narrow limits (called Wakhan) include the lofty spurs of the northern flank of the Hindu Kush, which in this area is traversed by a number of high and difficult passes, the lowest and best known of which is the Baroghil (12,460 ft.). The backbone or main water divide of the Hindu Kush continues to form the boundary between Afghanistan and the North-West Frontier province of India until it reaches Nuristan. From near the Dorah pass (14,800 ft.), which connects Chitral with the Afghan province of Badakshan, a long straight, snow-clad spur reaches southward, which divides the Nuristan valley of Bashgol from that of Chitral, and this continues to define the eastern limits of Afghanistan till it nearly touches the Chitral river opposite the village of Arnawai, 45 mi. south of Chitral. Here the Bashgol and Chitral valleys unite and the boundary passes to the water divide east of the Chitral river; along this water divide it extends to the Nawa Kotal. From here to Palosai on the Kabul river the exact line is (1946) undetermined. From Palosai the line runs due south till it reaches the hamlet of Torkham at the western extremity of the Khyber pass. It then turns west following the main ridge of the Morgha and Safed Koh ranges which divide Afridi Tirah from the Eastern province, and then, rounding off the cultivated portions of the Kurram valley below the Peiwar, it crosses the Kaitu and passes to the upper reaches of the Tochi. Crossing these again, it is continued on the west of Waziristan, finally striking the Gomal river at Domandi. From Domandi (the junction of the Kundar river with the Gomal) the Afghan boundary marches with that of Baluchistan. (*See* BALUCHISTAN.) It is carried southwest mainly along the Kundar and Kadanai to a point beyond the Sind-Peshin terminal station of New Chaman, west of the Khojak range, and then drops south to Shorawak and Nushki. From Nushki it crosses the Helmand desert, touching the crest of a well-defined watershed for a great part of the way and, leaving Chagai to Baluchistan, it strikes nearly west to the Iranian frontier, and joins it on the Koh-i-Malik Siah mountain, south of Seistan.

From Koh-i-Malik Siah the boundary with Iran runs northeast till it reaches the Helmand river which it follows northward, leaving the town of Nasratabad (Nasirabad) and the Hamun to Iran. It then bends to the west as far as the Siah Koh mountain. Thence it runs through desolate country in a generally north-northwesterly direction till it turns for a short space northeast so as to leave the important valley of Yazdan within the Iranian frontier. It then turns northwest to the Namaksar (salt lake) which it crosses, and veers northeast across the Hashtadan plain to join the Hari Rud at the point where this river bends north. The boundary then follows the course of the Hari Rud to Zulfikar.

**Principal Features.**—The dominant feature of Afghanistan is the great central range of mountains which divides the country approximately from east to west. This range, known in its eastern portion as the Hindu Kush, takes off from the Little Pamir in the extreme northeast, and after forming the boundary between Chitral and Afghanistan to a point south of the Dorah pass turns westward, and spreads across central Afghanistan in a series of deep ravines and broken ridges gradually diminishing in height from the eastern peaks of 24,000 ft. Opposite Kabul and some 150 mi. to the north of it, the main ridge is about 20,000 ft. in height. Farther west it spreads out fanwise in a series of subsidiary ranges, such as the Paghman range (16,000 ft.), while the main ridge continues westward under the names of the Koh-i-Baba (15,000 ft.), the Band-i-Baian (13,000 ft.) and the Band-i-Baba (12,000 ft.), and finally the Paropamisus mountains which continue as a series of low ridges in a northwesterly direction till they reach the valley of the Hari Rud.

Round the central structure the country is divided into four main divisions depending on the four principal river systems. In the north the high pastures of Badakshan descend to the valley of the Oxus and the rich lands of Afghan Turkistan with its principal city, Mazar-i-Sharif. In the west the valley of the Hari Rud contains the city of Herat and the fertile surrounding country. In the southeast the valley of the Helmand and its tributaries water the city of Kandahar and the country to the north and east. In the centre and east the Kabul river system, which includes among its tributaries the Logar, Panjshir and Kunar rivers, waters the Kabul plateau, the rich valleys of Chardeh and Koh-i-Daman, and at a lower altitude the country of the Eastern province round Jalalabad. Subsidiary to these main divisions are the valley of the Murghab river in the northwest, and the area round the headwaters of the Kurram, Tochi and Gomal rivers in the southeast.

**Climate.**—Three main traits are characteristic; namely, extremes of temperature (both seasonal and diurnal), wind and dryness, in respect to which elevation rather than latitude is the chief deciding feature. In the north the valley of the Oxus has a temperature which may rise to 112° F. in the summer, while in Kabul and Ghazni on the southern side of the main range the maximum shade temperature rarely rises above 100° F. The minimum temperature in these areas falls as low as −10° to −15° F. in February. At Kandahar and Jalalabad on lower levels the variation is between 110° and 15° F. In the north the daily variation of summer temperature exceeds 30° F.

The heat of summer is aggravated by hot winds, particularly on the western frontier from Herat to Seistan where a wind with a velocity which reaches 110 m.p.h. blows continuously from June to September. In winter periodic blizzards from the northwest bring heavy falls of snow at altitudes of more than 5,000 ft.

The average yearly rainfall is 11 in., the greater part of which falls between December and April. An occasional shower falls in summer, but the influence of the southwest monsoon hardly extends to Afghanistan.

Generally speaking the climate is good. At altitudes in the neighbourhood of 6,000 ft. the spring and autumn are particularly fine, with clear cool days and nights and a dry invigorating atmosphere.

**Flora and Fauna.**—On the main ranges at 6,000 to 10,000 ft. grow large forest trees, among which conifers are most prominent, such as *Cedrus deodara, Abies excelsa, Pinus longifolia, P. pinaster, P. pinea* (the edible pine) and the larch. Yew, hazel, juniper, walnut, wild peach and almond are also found. Growing under the shade of these are several varieties of rose, honeysuckle, currant, gooseberry, hawthorn and luxuriant herbage, the Ranunculaceae being abundant and rich in genera. The lemon and wild vine are commonest on the northern mountains. The walnut and oak (evergreen, holly-leaved and kermes) descend to the secondary heights, where they become mixed with alder, ash, khinjak, *Arbor-vitae,* juniper, *Indigofera* and dwarf laburnum, with species of *Astragalus,* etc. Lower again and down to 3,000 ft. grow wild olive, species of rock-rose, wild privet, acacias and mimosas, barberry and *Zizyphus;* and, in places, *Chamaerops humilis* (which is applied to a variety of useful purposes), *Bignonia* or trumpet flower, sissu, *Salvadora persica,* verbena, acanthus, varieties of *Gesneria.* The lowest terminal ridges, especially toward the west, are naked in aspect. Their scanty vegetation is almost wholly herbal; shrubs are only occasional; trees almost nonexistent. Labiate composite and umbelliferous plants are most common. Ferns and mosses are almost confined to the higher ranges. On the dreary Kandahar tablelands grow many vigorous plants, such as papilionaceous *Leguminosae,* and the camel-thorn (*Hedysarum alhagi*), *Astragalus* in several varieties, spiny rest-harrow (*Ononis spinosa*), the fibrous roots of which often serve as a toothbrush; plants of the subfamily *Mimosa,* such as the sensitive mimosa; a plant of the rue family, called by the natives *lipâd;* the common wormwood; also certain orchids, and several species of *Salsola.* Rue and wormwood give domestic medicines—the former for rheumatism and neuralgia; the latter for fever, debility and dyspepsia, as well as for a vermifuge. The *lipâd,* of heavy nauseous odour, is believed to keep off evil spirits. On some sides and hollows of ravines are found rose-bay (*Nerium oleander*), called in Persian *khar-zarah,* or assbane, wild laburnum and various *Indigofera.* The chief cultivated trees are mulberry, willow, poplar, ash and occasionally the plane.

Of commercial value is the gum resin of *Narthex asafoetida* of the high and dry plains of western Afghanistan, especially between Kandahar and Herat. In the highlands of Kabul edible wild rhubarb is an important local luxury. Walnut and edible pinenut are both wild growths, which are exported. The *sanjît* (*Elaeagnus orientalis*), common on the banks of watercourses, furnishes an edible fruit. The dried tuber of a mountain orchis affords the nutritious mucilage called *salep;* a good deal of this goes to India. *Pistacia khinjuk* affords a mastic. The true pistachio is found only on the northern frontier; the nuts are imported from Badakhshan and Kunduz. Mushrooms and other fungi are also used as food.

Wild animals include the wolf, fox, hyena, wild dog, wild cat, common leopard, mongoose, wild sheep, mole, shrew, hedgehog, bats, several species of jumping mouse, jerboa and pica hare.

Bears are found in the forests and the Mongolian tiger inhabits the thick reed country of the Oxus.

Of the goat family the markhor, oorial and ibex are found in the central ranges, while the wild sheep, ovis poli and ammon inhabit the Afghan Pamirs. Two types of deer are said to exist.

There are said to be 124 specimens of birds including several varieties of pheasants, duck, teal, cranes, pelican, snipe, partridge and chikor. Smaller birds include the golden oriole, magpie, bulbul, swallow, quail and sparrow. Brown trout (*Salmo oxiensis*) are plentiful in some of the rivers of the Oxus basin; mahseer and snow trout (*chush*) are found in the rivers of the Indus watershed.

**Agriculture and Animal Husbandry.**—Afghanistan is mainly a pastoral country. Of a total area of about 270,000 sq. mi. probably not more than 20,000 sq mi. are under cultivation. The remainder consists of desert land in the south and south-east, and of highland country providing seasonal grazing throughout the year. On the whole the soil is fertile, particularly in the wide loess plains north of the Hindu Kush and in the eastern and southern areas. In these places and along the valleys wherever irrigation is possible good crops are obtained. Irrigation is carried out by means of a network of channels, often many miles in length, and sometimes subterranean (*karez*), and attention has been directed by the government to the construction of irrigation dams to conserve flood waters, and of canals. Dry farming is also practised in certain areas.

The principal crops are wheat, the staple food of a large portion of the inhabitants, rice particularly in the valleys, barley and lucerne for fodder, sugar beets, Indian corn, millet, lentils and mustard seed. Vegetables are extensively cultivated and include potatoes, carrots, turnips, onions, chillies, tomatoes, sugar cane, peas and cabbages.

Horticulture is largely practised, particularly around Kabul and Kandahar where the Sardas melon is famous. Grapes of many varieties and excellent quality are exported in large quantities to India. Other fruits include all well-known European varieties. The mulberry is grown extensively and in some localities forms the staple food of the inhabitants. Dried and crushed with walnuts it is made into a cake (*tulchan*) and stored for winter use.

Domestic animals include sheep of which immense flocks are to be found. The northern variety are famous as the producers of the Afghan lambskin (karakul). Cattle of various types are also kept in large numbers; horses, of which the northern variety (Turkoman) is the best known; donkeys, extensively used for light transport; camels of two types for heavy transport, goats and poultry.

The principal wealth of Afghanistan lies in the flocks and herds which roam the great pasture lands below the mountains. From the pastures around Andkhui come the highest quality lambskin or astrakhan, while the southern sheep provide wool, mutton and melted butter (*ghi*). The cattle are kept chiefly for milk and also provide a considerable quantity of skins and hides.

**Minerals.**—A complete geological survey of Afghanistan still (1946) remains to be carried out. The following are the principal minerals known to exist.

Extensive coal-bearing strata have been located and surveyed in the area south of Haibak and between it and Ishpushta on the north road The exploitation of this deposit which runs into many millions of tons and is said to be of good quality is hampered by the difficulties of the mountainous country in which it is situated. A survey of the country in 1937–38 disclosed favourable indications of petroleum beds in the northern provinces which, however, have proved unattractive to oil companies because of their distance from the sea. Large deposits of rock salt are worked in northern Afghanistan, while brine deposits at Andkhui and Herat supply the western part of the country. Reports of the reopening of the former gold mine near Kandahar have hitherto proved false, but alluvial deposits of gold are said to exist in the bed of the Oxus and elsewhere. Silver is reported in Hazarajat; the silver mines in the Panjshir valley are no longer worked. Large deposits of iron ore have been found on the southern side of the Hindu Kush in the Ghorband valley, and there are occurrences of lead ore elsewhere. Sulphur, gypsum and alabaster are all to be found in some quantity in the area of the Kamard valley on the northern slopes of the Hindu Kush There is a ruby mine on the Jagdalak pass east of Kabul, while lapis lazuli of high quality is found in Badakshan, though the mine has not been worked for some years.

**People.**—The term Afghan really applies to one section only of the people, but this is the dominant section known as the Durani. The Ghilzai (almost as powerful as the Durani) are believed to be of Turkish origin; the Hazaras, the Chahar-Aimak, Tajiks, Uzbegs, Nuristanis and others are more or less subject races. Popularly any inhabitant of Afghanistan is known as Afghan on the Indian frontier without distinction of origin or language; but the language division between the Parsiwan (or Persian-speaking Afghan) and the Pathan of the Indian frontier is a very distinct one. All upper-class Afghans speak the Persian language. The predominance of the Afghan in Afghanistan dates from the mid-18th century, when Ahmad Shah carved out Afghanistan from the previous conquests of Nadir Shah and called it the Durani empire.

The Durani Afghans claim to be Ben-i-Israel, and insist on their descent from tribes carried away captive from Palestine to Media by Nebuchadrezzar. Yet they also claim to be Pukhtun (or Pathan) in common with all other Pushtu-speaking tribes, whom they do not admit to be Afghan. The bond of affinity between the various peoples who compose the Pathan community is simply the bond of a common language. All of them recognize a common code or unwritten law called Pukhtunwali, which appears to be similar in general character to the old Hebraic law, though modified by Mohammedan ordinances, and strangely similar in some points to Rajput custom. Besides their division into clans and tribes, the whole Afghan people may be divided into dwellers in tents and dwellers in houses; and this division is apparently not coincident with tribal divisions, for of several of the great clans at least a part is nomad and a part settled. Such is the case with the Durani and with the Ghilzai.

**Dominant Stock.**—Afghans have fine figures, aquiline profiles, fair complexions and a small group yielded an average cephalic index of 74.8, a value nearer to that found among Rajputs in Indian than to that among the Pukhtun (Pathan) groups (av. ceph. ind. 80–83) of the Indian frontier or to that among some of the subject peoples. Among the latter, the Hazaras are tall, very broadheaded (av. ceph. ind. 85.0) and akin in feature to peoples of parts of Turkistan and Mongolia; they are said to have been planted in Afghanistan by Jenghiz Khan, and they inhabit especially the mountains west of Kabul. The Tajiks are as broadheaded as the Hazaras but belong to the pale rosy-skinned rather than to the yellow-skinned stock; they seem to be an old-established, settled, agricultural people.

Tribal law, with the custom of hospitality, and the vendetta in many forms are rules of life, and even the settled Afghan is very much a soldier. They have great power of endurance, and are frequently lawless and fanatical But their character is lightened by a sense of humour, and a ready wit and courtesy which makes them pleasant to deal with, though in business affairs poverty has made them often avaricious and hard bargainers. Among their rulers are to be found men of fine character and discrimination

who are essaying the task of civilizing a difficult people with some success.

The cultivators, including owners, tenants, labourers and slaves, are skilled irrigators, utilizing every fragment of profitable land; some of the Ghilzai are specially skilled in boring underground water channels (*karez*). The settled folk live chiefly in village communities and leave handicraft and commerce largely to subject races save that some Ghilzai are wandering traders (*powindaks*). Afghanistan is a stronghold of Islam, of the Sunni sect for the most part, though the Hazaras and others are Shiah. The last stronghold of idolatry, Kafiristan, to the north of Jalalabad was subdued in 1895 and the people converted to Islam, their country's name being changed to Nuristan, or "Land of Light." Some of the Durani Afghans of Kandahar and Zamindawar districts are very fanatical "Ghazis," that is, men who have vowed their lives to the extinction of other creeds.

**Language.**—Pushtu, the language of the Pathans, is spoken by about one-third of the population, and principally in the eastern and southern areas. It belongs to the Aryan subdivision of the Indo-European group of languages, and is divided into two main divisions, the soft dialect spoken in the Kandahar area and the hard spoken by the eastern tribes. An endeavour is being made to convert it into the national language, but difficulties of vocabulary and pronunciation tend to preserve as the official language a somewhat archaic form of Persian which is spoken at court, and widely used by Tajiks, by the Mongols of Hazarajat and other non-Pathan inhabitants of central Afghanistan. Turki is spoken by the Uzbegs and other tribes of Turkish origin to be found in northern Afghanistan. Pushtu has no literature in the accepted sense of the term. A Khattak chief of the 17th century, Khushal Khan, wrote ballad poetry of a virile type, and at different times after that there have been Afghan verse writers. A collection of songs of the Afghans is in existen[illegible] little artistic merit.

**Administration.**—Until the accession of Amanullah in 1919 the government of the country was an absolute monarchy. After that time a system of democratic government was evolved, but evolution was inevitably slow in so backward a country and much power still rests in the hands of the king and his immediate advisers.

The administration is carried on by a national council (*Majlis-i-Shura-i-Milli*) composed of approximately 110 members elected from the various provinces at three yearly intervals, and by a house of nobles (*Majlis-i-Aiyan*) of 45 persons appointed by the king. The executive body is the cabinet consisting of the prime minister and 14 other ministers, and includes a minister for national defense, interior, foreign affairs, justice, commerce, revenue and education. In addition there is a national assembly (*Loe Jirga*) consisting of more than 1,000 delegates from all provinces which meets only at times of great national emergency.

For administrative purposes Afghanistan is divided into seven major and two minor provinces, Kabul, Kandahar, Herat, Mazar-i-Sharif, Eastern province, Southern province and the Kataghan and Badakshan province. The minor provinces are Farah-Chakansur and Maimana. Each province is in charge of a governor and is subdivided into districts (*Hakumat*). The governor is assisted by local officials in charge of revenue, justice, communications, health and so on. The ten larger towns are controlled by municipal committees under a president (*Rais-i-Baladiyah*).

All Afghan subjects and foreigners of non-diplomatic status are subject to Mohammedan religious law (*Shariat*). A code of laws is in existence but its provisions are complicated and not easily understood by the general public. The courts range from the police (*Haquq*) court to the high court of appeal (*Tamiz*). Punishments vary from the death sentence which requires confirmation by the king to fines.

No budget of national income and expenditure is published but the annual revenue is believed to be in the neighbourhood of $16,000,000. The main sources of revenue are land taxes and customs duties.

After 1931 primary education was compulsory. Secondary schools were established in the main centres, while for higher education Afghanistan still relies on the universities of India and other foreign countries to which selected students are sent each year.

**Communications.**—There are no railways in Afghanistan. Main roads connect the principal centres of the country and link up with the Indian road system at Torkham and Chaman, and with Iran at Islam Kila west of Herat. A road driven through the passes of the Hindu Kush to connect Kabul directly with the northern provinces was opened in 1933. The main roads though usually metalled and fit for wheeled traffic are rough and often impassable through snow in the winter months. A system of fairweather secondary roads was being developed throughout the country in 1946. There is no regular air service in Afghanistan. The Russians maintain an irregular air service for the conveyance of mail and diplomatic personnel while a service connecting Kabul with Berlin was operated for a short time in 1938–39 by the Luft-Hansa company.

Afghanistan is a member of the International Postal and Telegraph union. Post offices have been established in the principal towns and regular motor mail services are in operation. A telegraph and telephone system links the provinces with the capital, while a world-wide radio installation connects Kabul with the outside world.

**Commerce and Industry.**—The plan for the economic development of Afghanistan adopted by Nadir Shah and his advisers in 1932 was based on the partial industrialization of Afghanistan. This plan included the installation of hydroelectric works, the erection of textile factories, of machinery for the extraction of sugar from beet and of cotton ginning and other plants. The principal object of these schemes is to enable Afghanistan to be self-supporting so far as possible in certain essential commodities, and so avoid the necessity for extensive importation of basic requirements. At the same time state-controlled companies have been formed to regulate the purchase and sale of the principal imports and exports, while the financial equilibrium of the state is [illegible] by the establishment of a national bank with branches at home and abroad.

The principal export commodities are the Afghan lambskin, of which more than 1,000,000 are exported annually; wool; cotton; fruit, both fresh and dried; nuts; hides and skins; cattle felts; sheepskin coats (*postins*); carpets; asafoetida; and timber. Imports consist principally of textiles, piece goods, sugar, petroleum products, machinery, hardware and manufactured rubber goods.

The greatest volume of trade is with India and Russia except for the export of lambskins, the principal market for which was (1945) the United States.

**Archaeology.**—There is an extensive field for archaeological research in Afghanistan. A French archaeological mission enjoyed a monopoly of research after 1922, and did much valuable work among the Buddhist remains at Hadda near Jalalabad, at Bamian, where the famous giant statues of Buddha cut in the cliff face still stand, and around Kabul. Their discoveries include a remarkable find in 1938 at Begram, site of one of Alexander's cities, and subsequently a principal city of the Kushan empire. But much remains to be done. The ruins of Balkh (Mother of Cities) near Mazar-i-Sharif, and once a great entrepôt for trade between China and the west, are still untouched, the Sasanian cities of Seistan still lie half buried in the sand, and Mahmud's great city of Ghazni awaits excavation. In addition there are many areas in Wakhan on a branch of the old silk road, on the Indian frontier and in the valleys of the Hindu Kush which have yet to be explored (1945).

**The Armed Forces.**—The organization of the army is based on a scheme formulated in 1917 for an establishment of six corps with headquarters at Kabul (two corps), Jalalabad, Matun, Herat and Mazar-i-Sharif. Additional corps or divisions are now located at Kandahar, Ghazni, Urghun, Khanabad and Gardez. Recruitment is on a voluntary basis with some element of compulsion since quotas are allotted to areas. The total strength of the army in 1939 was about 60,000, but was raised during the

World War II period, chiefly by the recall of discharged men. It is probable that in the event of war numbers could be raised to 100,000 with 300,000 to 400,000 armed levies. The forces are armed with modern weapons including a few tanks. Military schools under Turkish supervision are in operation A certain amount of motor transport was purchased to increase the mobility of the army, and reorganization is in progress with the object of providing a central reserve at headquarters from which a mobile striking force could be furnished to support provincial troops.

A small air force is in existence and provides a useful means of carrying out reconnaissance in a country where communications are difficult and of overawing unruly tribesmen.

The king is head of the armed forces, and is advised by a minister of national defense, who is also commander in chief.

## HISTORY

The geographical term Afghanistan ("land of the Afghans") is an anachronism as applied to the country before 1747, when it first became a separate and independent state, and though it is now the official name of the kingdom it is not in common use among the Afghans.

The Afghan chroniclers call their people *Ben-i Israil,* or "Children of Israel," and claim for them descent from King Saul, whom they call *Tālūt,* through a son named Jeremiah, who is said to have had a son named Afghana; but this legend assumes so many conflicting and improbable forms that it may be safely regarded as a late invention. According to one account Afghana was settled by Sulaiman (Solomon) in the Sulaiman mountains, and according to another, evidently connected with the account of the captivity of the Ten Tribes, his descendants were removed from Palestine by Nebuchadrezzar and found their way to the mountainous country about Herat. Another legend related that in pre-Islamic times Bilo (father of the Biluchis), Uzbak (father of the Uzbaks) and Afghana were considered as brethren. The historian Firishta cites a legend which makes the Afghans Copts, of the race of pharaoh; and the Afghans explain their conversion to Islam by a story to the effect that nine years after Mohammed's announcement of his mission a holy man named Kais, sent to Medina to make inquiry of him, became a zealous Moslem and on his return converted his countrymen, adding that all true Afghans are descended from Kais and his three sons, but ignoring the other descendants of Afghana. Omitting the legend which attributes to the Afghans a Coptic descent we find the grandson of King Saul made contemporary with Mohammed Uzbak Khan, who flourished in the 14th century, as well as with King Solomon; and Kais, whose name suggests Kish, Saul's father, made contemporary with the prophet Mohammed.

Despite these and other discrepancies some intelligent British officers, well acquainted with the Afghans, have accepted the story of their Hebrew descent. Their belief has been based on certain Afghan customs and on the fancied resemblance of a well-known type of Afghan physiognomy to the physical characteristics of the Jews; but the Afghans, as Moslems, have many customs similar to those of the Hebrews, and they share their physical resemblance to the Jews with other rāces in no way connected with them.

**Early Period.**—Until 500 B.C. Afghanistan formed part of the Achaemenian empire, and comprised the ancient provinces of *Aria,* or Hari Rud; *Bactria,* or Balkh; *Drangiana,* or Seistan and the Helmand valley; *Arachosia,* or Kandahar; and *Paropamisus,* the region of the Hindu Kush and Kabul. The population in the north was Iranian, and in the south contained a large Indian element; but the most interesting people mentioned in the Greek records are the *Paktyes* in Arachosia, which Herodotus calls *Paktyike,* for in their name we may trace that of the *Pakhtun* or Pushtun, by which the Afghans still describe themselves. The story of Alexander's campaign in the eastern provinces of the Persian empire need not be repeated here, but the cities of Herat (Alexandria Arion) and Kandahar (Alexandria Arachosion) were either founded or restored by him.

He was succeeded in the eastern provinces of his empire by Seleucus Nicator, the founder of the Seleucid dynasty, but the Indian provinces and the Kabul valley fell to Chandragupta (*Sandracottus*), the founder of the Maurya dynasty.

**Greek Dynasty.**—As the power of the Seleūcids waned an independent Greek dynasty was established, about 246 B.C., in Bactria, and about 50 years later annexed a great part of northwestern India, but Afghanistan passed from its possession into that of the Parthians (who occupied its western provinces), and the Sakas, a Scythian tribe, who conquered the eastern provinces about 130 B.C. and gave their name to Seistan (*Sakastan* or *Sakastene*). Within 200 years the Yue-chi (*q.v.*), another central Asian tribe, expelled the Parthians and founded the Kushan dynasty, which ruled Afghanistan, and, at the height of its power, northern India, as far as Benares on the east and Malwa on the south This dynasty adopted the Buddhist religion, and Kanishka, the greatest king of the line, convened the great council which settled the canon of northern Buddhism, and is mentioned as a champion of Buddhism by Hiuen Tsang, the Chinese pilgrim; al-Biruni, the Mohammedan traveller, philosopher and geographer; and in the Mongol versions of the Buddhist story.

The empire of Kanishka did not long survive his death, but Kushan principalities continued in the southeastern valleys of the Hindu Kush, until they were overrun by the Ephthalites, or White Huns, who held possession of northern and eastern Afghanistan in the 5th and 6th centuries A.D.

**The Caliph Empire.**—The title of Arab conquest and Islamic propaganda in the 7th century reached western Afghanistan, and penetrated as far as Kabul where, however, Hindu dominion soon afterward asserted itself. As the power of the caliphs declined their provincial governors founded dynasties owning a nominal allegiance to them but virtually independent. One of the earliest of these was the Arab dynasty of the Tahirids, who included Herat and Balkh in their kingdom of Khurasan, in which they were succeeded by a native Persian dynasty, the Saffarids, who were overcome in the 9th century by the Samanids of Balkh and Bukhara, another Persian house. Alptigin, a Turkish slave of this house, established himself in Ghazni, where he was succeeded, after a short interval, by another Turkish slave, Sabuktigin, who threw off the yoke of the Samanids and annexed to his dominions not only the Hindu kingdom of Kabul, but the territory lying between it and the Indus. Assistance given by him to the Samanids was rewarded with the government of Khurasan, to which he appointed his elder son Mahmud, and Afghanistan became the nucleus of a great empire. Sabuktigin died in 997, and his son Mahmud, after deposing a younger brother, ascended the throne in 998. The tale of his predatory raids into India need not be repeated here. He added to his empire Baluchistan, and, later in his reign, the Indian kingdom of the Punjab, the province of Multan and the greater part of western Persia, and divided with Ilak Khan, the founder of a Turkish dynasty in Transoxiana, the dominions of the house of Saman, which came to an end during his reign.

The hitherto obscure town of Ghazni now became a great and splendid city, for Mahmud was no mere ravager and despoiler. It is in Mahmud's reign that we first hear of the small state of Ghor, in the ranges southeast of Herat, which Mahmud reduced to vassalage, and the rulers of which, eventually, extinguished his dynasty. He himself paved the way for the destruction of his empire by admitting into Khurasan the Seljuk Turks, who afterward stripped his descendants of their possessions in the north and west and founded a great empire on the ruins of that of Ghazni.

Mahmud died in 1030 and his descendants continued to reign over a gradually diminishing empire, with Ghazni as their capital, until 1140, when Alauddin Husain, chief of Ghor, to avenge the death of his brother, Saifuddin, who had been treacherously put to death by the sultan of Ghazni, captured and burnt the city, driving Mahmud's descendant, Khusrav Shah, into the Punjab. The destruction of the great city of Ghazni earned for its author the cognomen of *Jahansuz,* "the World-Burner."

**Ghor Dynasty.**—In 1186 the World-Burner's nephew, Muizzuddin Mohammed, commonly known as Mohammed Ghori,

treacherously enticed Khusiav Malik, the last of the Ghaznavids, from Lahore, and imprisoned him for the short remainder of his life. Having secured the Punjab, Mohammed invaded India, and founded there a Moslem empire which endured, in name at least, until 1858.

This dynasty of Ghor is commonly believed to have been of Afghan origin, but the belief rests on a very slender foundation of evidence. Legend also assigns it descent from Zahak; and though this is no better attested than their Afghan genealogy, it seems to be probable that they were Tajiks of Persian race. The Afghans themselves are Indo-Iranian by race, and their antiquity as a separate people is uncertain. Firishta's statement that the inhabitants of the Sulaiman mountains were known as Afghans in the 1st century of the *Hijra* (the 7th century of the Christian era) carries no weight, but the name occurs in al-'Utbi's *History of Sultan Mahmud,* written about A.D. 1030, coupled with that of the Khalaj or Khaljis, who were apparently a Turkish tribe domiciled in western Afghanistan, but always antagonistic to the true Afghans. Both names occur in the history of India during the 13th and 14th centuries, and the Indian historians are not careful to distinguish between the two peoples. Hence it is, probably, that some Europeans have carelessly classed all the five dynasties which preceded the Timurids on the throne of Dihli as "Pathans," or Afghans, though in fact two of them were Turkish, one was Khalji and one was of Arab descent.

The Moslem empire in India was founded by a manumitted slave of Mohammed Ghori, and shortly after Mohammed's death his great empire fell to pieces and was divided between provincial governors and members of his own family holding small principalities in Afghanistan. These petty princes were subdued by the shahs of Khvarazm, or Khiva, of whose great but ephemeral empire Afghanistan for a time formed part.

**Mongol Rule.**—In the 13th century Afghanistan, like Persia, suffered the dreadful calamity of invasion by the heathen Mongols of Jenghiz Khan, who settled to the north of the Hindu Kush; but the rest of the country, owing to its inhospitable nature, suffered less than more fertile and populated lands. It was here, however, that the gallant Jalaluddin, last of the shahs of Khvarazm, made his most strenuous efforts to avenge on these savages the annexation and devastation of his kingdom.

The greater part of Afghanistan remained under Mongol rule until the rise of Timur Lang (Tamerlane), who established himself in northern Afghanistan in the latter part of the 14th century, wresting Herat from the Kurts, a family which claimed descent from the princes of Ghor (*see* MONGOLS).

**The Moghul Empire.**—In 1504, Babur, fifth in descent from Timur, having been expelled from his ancestral dominions in Transoxiana, occupied Kabul and made it the capital of a kingdom which he established in Afghanistan; and in 1522 he captured Kandahar from the Arghans, a Moghul family which had long held it, but he did not remain long content with his Afghan kingdom. In 1526 he invaded India, defeated Ibrahim Lodi, the Afghan sultan of Delhi, on the field of Panipat, and founded the state which is usually known to Europeans as the Moghul empire, though Babur was no Moghul, and would have resented the designation. Kabul and Kandahar remained for the time merely provinces of Babur's Indian empire, and Herat fell into the hands of the Safavi shahs of Persia.

Babur's son, Humayun, was expelled from India by the Afghan, Sher Khan, and was compelled to seek an asylum with Shah Tahmasp of Persia, who helped him to recover Kandahar, held by his rebellious brother. From Kandahar Humayun proceeded to Kabul, from which city he ousted another brother, and after spending seven years in re-establishing his authority in Afghanistan was able, in 1554, to recover his Indian empire, but died shortly afterwards, as the result of an accident, leaving the task of extending and consolidating the dominions of his house in India to his young son Akbar (*q.v.*), the real founder of the "Moghul" empire of India.

Afghanistan was then divided, Kabul remained a province of India, and Herat a province of Persia; Balkh fell to the Uzbegs of Transoxiana, and Kandahar, after remaining for a time in the possession of the Timurids, was taken by the Persians Akbar's grandson, Shah Jahan, recovered Balkh and the surrounding country which he held for another ten years till Uzbeg pressure finally caused the Moghuls in 1648, to relinquish hold of their provinces beyond the Hindu Kush.

In 1708 the Ghilzais of Kandahar, who perhaps represented the Khalaj, provoked by the oppressive rule of the Persian governor, Shahnavaz Khan, a Georgian prince of the Bagratid house, rose under Mir Vais and expelled the Persians. Mir Vais defeated the Persian armies sent against him and established his independence, but died in 1715. His son Mahmud, carrying out a project of his father's, invaded Persia, besieged Isfahan and in Oct. 1722 compelled Shah Husain, the feeble Safavid, to surrender his crown to him, but the rule of the Ghilzais in Persia was brief—Mahmud died mad and his successor, Ashraf, was defeated by Nadir Kuli, the Afshar, who shortly afterward ascended the throne. In 1737–38 Nadir Shah, one of Persia's greatest monarchs, recovered Kandahar and conquered the Indian province of Kabul, but conciliated the Afghans and enlisted many in his army—among them Ahmad Khan, a young chieftain of the Sadozai family of the Abdali tribe. Ahmad Khan rose to high rank in the Persian army, and after the assassination of Nadir Shah in 1747 was chosen by the Afghan chiefs at Kandahar as their leader and assumed the royal title Among his titles was that of *Durr-i-Dauran,* "the Pearl of the Age," from which his tribe received the name of Durani.

The land of the Afghans had been successively a congeries of petty states, the centre of great empires ruled by foreigners and a dismembered country, furnishing provinces to three monarchies. It now became, for the first time, a distinct political entity, ruled by an independent native sovereign.

Ahmad Shah Abdali extended his kingdom westward nearly to the Caspian and eastward over the Punjab and Kashmir, which he wrested from the feeble successors of Babur on the throne of Delhi. He claimed and commanded the allegiance of Sind, which had been ceded by Mohammed Shah of Delhi to Nadir Shah. His northern boundary was the Oxus, and Baluchistan and Khurasan were tributary states of his kingdom. At the third battle of Panipat, fought on Jan. 14, 1761, he inflicted on the confederate Maratha chiefs, who were then at the zenith of their power and were the real masters of the great empire founded by Babur and Akbar, a crushing defeat, and with inferior numbers nearly annihilated their great army.

**Foreign Influences.**—Ahmad Shah died in 1773 and was succeeded by his son Timur, who transferred his residence from Kandahar to Kabul. In his reign Sind was lost, Balkh and other districts in Afghan Turkistan became virtually independent, and the seeds of revolt were sown in Khurasan and Kashmir. He died in 1793, leaving 23 sons, of whom the fifth, Zaman Mirza, by the help of Payinda Khan, head of the Barakzai family of the Durani ascended the throne. His reign was short and troubled and was marked by one act destined to have momentous consequences—the grant of Lahore, in 1799, to the Sikh adventurer, Ranjit Singh. In the following year Mahmud, another son of Timur, ousted Zaman Shah and ascended the throne, but in 1803 was deposed by conspirators who placed his brother, Shuja-ul-Mulk, on the throne. In 1809 the East India company's government in India, alarmed by the intrigues of Napoleon in Persia, sent Mountstuart Elphinstone as envoy to Shah Shuja at Peshawar, but Napoleon's ambitious eastern schemes came to nought, and the British mission at Peshawar was unable to effect anything, for Shah Shuja's rule was unpopular, and while his army was engaged in quelling a rebellion in Kashmir his deposed brother, Mahmud, rose in rebellion, defeated him and put him to flight, and ascended the throne for the second time. In 1815 Shah Shuja took refuge in India and remained a pensioner of the Indian government until, at a later date, a use was found for him. Mahmud ruled until 1818 but the real ruler of the kingdom was Fath Khan the Kingmaker, the eldest son of Payinda Khan Barakzai. It was he who recovered Herat, which had been seized by the Persians, and in the insolence of his power he ventured to offer a gross outrage to the Sadozai

family. Mahmud, already chafing under Fath Khan's yoke, avenged the insult by causing him to be blinded, and Mohammed Azim and Dost Mohammed, the minister's brother and half-brother, rose in arms against Mahmud, who retorted by causing Fath Khan to be put to death with torture. The Barakzais prevailed and in 1818 drove Mahmud from Kabul and dethroned him. A period of anarchy then ensued. Mohammed Azim ruled Kabul, but his brothers and other Afghan chiefs, the provincial governors, withheld their allegiance from him and the kingdom fell to pieces. Herat, always a Persian rather than an Afghan town, was alienated; Afghan Turkistan and Badakhshan regained their independence, and Ranjit Singh, who had already conquered Kashmir, Multan, Dera Ghazi Khan and Attock, was threatening Peshawar, which he secured by defeating the Afghan army at Naushahra in 1823. In the same year Mohammed Azim died, and the remaining Barakzai brothers plunged into a fratricidal war. Three years later Dost Mohammed established himself in Kabul, Ghazni and Jalalabad, and, having secured this fragment of the Afghan kingdom, assumed the title of amir, after having, in 1835, defeated an attempt by Shah Shuja to regain his throne.

Russia had succeeded France as the bugbear of British administrators in the east, and the fear of Russian intrigue, as well as the prospect of active hostilities between the Amir Dost Mohammed and Ranjit Singh, induced the company's government to despatch an envoy, Sir Alexander Burnes, to the court of the amir. His mission was ostensibly commercial, but he was instructed to oppose the attempt of the shah of Persia to recover Herat. He was well received, but the amir was disappointed by his refusal to pledge his government to aid him against Ranjit Singh, and consequently held himself in no way bound to refuse to receive Captain Vikovitch, a Russian officer who then arrived in Kabul. The governor-general, Lord Auckland, peremptorily demanded his dismissal and the renunciation of all claims to the Punjab and Kashmir, which Ranjit Singh had recovered from the Afghans, and rashly decided to make Dost Mohammed's natural refusal of these demands a *casus belli*, and to attempt to restore the fugitive Shah Shuja, who had already been tried and found wanting. Ranjit Singh, whose material interests were involved, bound himself to co-operate with the British, but when all was ripe for the invasion declined even to permit British troops to cross his territories, though a Sikh force, with Sir Claud Wade and a small British detachment, advanced through the Khyber pass.

The "Army of the Indus," numbering 21,000, assembled in upper Sind in 1838 and advanced through the Bolan pass under the command of Sir John Keane. It met with hardly any resistance and in April 1839 occupied Kandahar, where Shah Shuja was crowned in his grandfather's mosque. On July 21 Ghazni was taken by storm and Dost Mohammed, deserted by his troops, fled northward. On Aug. 7 Shah Shuja, escorted by the British army, entered Kabul. It was believed that the war was over, and Sir John Keane, who received a peerage for his services, returned to India with the greater part of the army, leaving Sir William Macnaghten as envoy and Sir Alexander Burnes as his colleague, with 8,000 British and company's troops and the contingent which had been raised for the service of Shah Shuja for their protection. The trouble was in fact only beginning, for the best of rulers is not acceptable to a free people when imposed upon them by foreign arms, and Shah Shuja had already rendered himself odious to the Afghans. He now, acting on the advice of the British resident, attempted to raise a regular army to take the place of the tribal militia under its hereditary leaders; but the opposition of the chiefs, who apprehended the diminution of their own power and influence and the extinction of their country's independence, ensured the failure of this design. Shah Shuja was obliged to rely more and more upon British assistance, and his rule grew daily more unpopular. A danger was removed by the surrender of Dost Mohammed, who was sent to India, but it was impossible to save Shah Shuja, and in Nov. 1841 discontent at Kabul culminated in a revolt in which Burnes and other officers were massacred. Akbar Khan, the son of Dost Mohammed, placed himself at the head of the national party, and at a conference with the British authorities stabbed Sir William Macnaghten with his own hand. The British agreed to evacuate the country, and, in accordance with a convention with the Afghans, the garrison, then reduced to 690 British and 3,810 Indian troops, with the enormous number of 12,000 followers, marched out of Kabul on Jan. 6, 1842. The Afghans made no pretense of observing the terms of the convention, and the retreat of the demoralized army in the depth of a severe winter was a scene of confusion and massacre. On Jan. 13 the survivors of the force mustered at Gandamak only 20 muskets, and Dr. William Brydon, the sole survivor of the army of Kabul, except those whom the Afghans had captured, reached Jalalabad alone. The garrison of Ghazni had been obliged to surrender, but Kandahar was held by General William Nott and Jalalabad by General Robert Sale. In April 1842 Shah Shuja was assassinated.

Preparations were made in India to avenge these disasters and to recover the prisoners. In April 1842 General George Pollock forced the Khyber pass and relieved Jalalabad, and in September reoccupied Kabul, where he was joined by General Nott from Kandahar, who had recaptured and dismantled Ghazni. The prisoners were recovered from Bamiyan, where the Afghans had lodged them, and the army evacuated Afghanistan in Dec. 1842 after destroying the citadel and the central bazaar of Kabul. Dost Mohammed was permitted to return to his country and assumed the government, with the title of amir.

In 1848, during the second Sikh war, Dost Mohammed was induced to go to the aid of the Sikhs. The adventure was unfortunate for him, for at the battle of Gujarat, in Feb. 1849, his cavalry was ignominiously routed and pursued as far as the hills, and the Peshawar territories were annexed to British India and thus lost to Afghanistan. Balkh was recovered in 1850 and Kandahar in 1855, in which year also a treaty of peace was concluded between him and the British government at Peshawar. In 1856 the Persians captured Herat but were obliged to surrender it to an independent ruler after the British expedition to Persia. In 1857 the amir met, at Peshawar, Sir John Lawrence, who promised him arms and a subsidy to aid him in defending his country against Persia, and a British mission under Major Lumsden was received at Kandahar. During the Indian mutiny the amir declined to listen to those who instigated him to aid the rebels, and remained faithful to his alliance.

In 1863 Dost Mohammed captured Herat after a long siege, and, dying almost immediately afterwards, was succeeded by his son Sher Ali Khan, the early years of whose reign were disturbed by contests with his brothers. Early in 1873 the British government succeeded in obtaining from the Russian government a declaration that Afghanistan was beyond the field of Russian influence, and the recognition of the Oxus as the northern frontier of the state. Later, the amir's failure to secure a British guarantee for his sovereignty and family succession, and his refusal to admit British agencies into Afghanistan led to estrangement between him and the British government, and when, in July 1878, he ostentatiously received a Russian mission at Kabul and shortly afterward refused to permit a British mission to cross the frontier, his attitude was regarded as definitely hostile. After some warnings the government of India delivered an ultimatum, his disregard of which led to the decision to invade Afghanistan. In Nov. 1878 the British forces inflicted severe defeats on the Afghan troops and occupied the Khyber pass and the Kurram valley, and early in 1879 occupied Kandahar, Kelat-i-Ghilzai and Girishk. The amir, with the Russian mission, had fled from Kabul, and he died, a fugitive, in March 1879. His second son, Yakub Khan, who was recognized by the people of Kabul as amir, voluntarily visited the British camp at Gandamak in May 1879 and there concluded a treaty, by the terms of which he ceded the Kurram valley, Pishin and Sibi, and the control of the Khyber and Michni passes and of the tribes in their neighbourhood. He also agreed to receive a British resident at Kabul and to subordinate the foreign affairs of Afghanistan to British influence. Major Sir Louis Cavagnari was well received by him as resident, but the amir was either unable or unwilling

to control the fanatical element in Kabul, and in Sept. 1879 the residency was attacked by a mob of townspeople and soldiers, and the resident and his escort were murdered after a gallant defense.

**Abdur Rahman Khan.**—The Kandahar force then concentrated at Kandahar, and a force under General (afterwards Field-Marshal Earl) Roberts advanced through the Kurram valley, defeated an Afghan force at Charasia and occupied Kabul on Oct. 12, 1879. Yakub Khan, having entered the British camp, abdicated, and was sent to India, where he lived for the rest of his life. The British force under Roberts remained at Kabul, and in July 1880 the British government recognized a new amir, Abdur Rahman Khan, a grandson of Dost Mohammed and nephew of Sher Ali.

Sardar Sher Ali Khan, a Barakzai of Kandahar, had already been recognized as independent ruler of that province, but in July 1880 Ayub Khan, a younger brother of Yakub Khan, advanced from Herat, inflicted a crushing defeat on a brigade of British troops at Maiwand and invested Kandahar On Aug. 8 General Roberts left Kabul with a relieving force, which reached Kandahar on Aug. 31, and on Sept. 1 defeated the besiegers and captured their camp, artillery and baggage. Ayub Khan fled with a few followers, and, peace having been restored in southern Afghanistan, the British forces evacuated the country in 1881. Sher Ali was unable to maintain his authority in Kandahar and retired to India, where he ended his days as a pensioner. Ayub Khan again took the field, defeated Abdur Rahman's troops, and occupied Kandahar, but in Sept. 1881 Abdur Rahman utterly defeated him and drove him to seek refuge in Persia. In 1888 he went to India, and lived there as a pensioner of the British government until his death.

Abdur Rahman had been recognized as amir of Kabul only, but within a year of ascending the throne had made himself master of Kandahar and Herat also, and he succeeded in quelling tribal disturbances and in establishing his rule on a firm basis. No attempt was made to fetter his independence except with regard to his foreign relations, which he agreed to conduct subject to the control of the government of India, from whom he received an annual subsidy to be devoted to the payment of his troops and the defense of his northwestern frontier, and considerable supplies of war material, together with facilities for importing arms through India at his own cost.

In 1884 it was agreed that a joint commission of British and Russian officers should demarcate the northern boundary of Afghanistan, but the Russian commissioners did not immediately arrive on the scene, and in March 1885 while the amir was conferring with Lord Dufferin, the viceroy of India, at Rawal Pindi, Russian troops attacked and drove from Panjdeh, a small town on the frontier, an Afghan force. In 1888 the amir's authority was seriously menaced by the revolt of his cousin, Ishak Khan, who held a quasi-independent position as governor of Afghan Turkistan and caused himself to be proclaimed amir, but the rebellion was crushed. Ishak was expelled and settled at Bukhara as a pensioner of the Russian government, and Abdur Rahman's authority was established in the northern province. In 1895 he completely subjugated Kafiristan, a wild mountainous tract to the northeast of Kabul, the inhabitants of which had hitherto successfully resisted all attempts to destroy their independence.

In 1893 encroachments by the amir into the country adjoining the settled districts of India caused the Indian government to negotiate a line of demarcation (known as the Durand line) defining the limits of the amir's authority on his eastern and southern borders.

In 1901 Abdur Rahman died, after a reign of 21 years, in the course of which he gave Afghanistan a government such as it had never known before. This he effected, first, by substituting for a feudal militia under tribal chiefs a standing army, well trained, well armed and regularly paid, owing allegiance to none but himself. By means of this force he was able to establish an efficient central administration, retaining all power in his own hands, and to improve the public revenues not only by increasing the burden of taxation, but by ensuring the collection of all assessed taxes. He was harsh and ruthless, but he relieved his subjects from the petty tyranny of local chieftains, and he suppressed highway robbery and violent crime. It is probable that he fully appreciated the advantages which his country might gain from projects of a commercial or strategical nature, such as railways, telegraphs and mines; but it was his settled conviction that these advantages would be purchased at too high a price by the necessary employment of large numbers of foreigners, whose activities in the country might have amounted to peaceful penetration and menaced Afghan independence

**Habibullah.**—Two days after the death of Abdur Rahman his eldest son was recognized as his successor. Habibullah introduced the reduction of taxation, the establishment of a council of state for tribal affairs and the association of tribal chiefs with provincial governors for the adjudication of tribal cases He also inaugurated military reforms. He loyally observed the condition regarding the control of the foreign affairs of Afghanistan on which the government of India had recognized his father as amir, but on all questions relating to the development of his country's trade and more intimate relations with the government of India he proved to be as wary and suspicious as his father had been. He consented, indeed, to receive a special mission under Sir Louis Dane, foreign secretary to the government of India which reached Kabul in Dec. 1904, but the mission failed to obtain any concessions, and the result of its work was merely the confirmation and ratification of existing agreements and the concession to him in the treaty of the title of "Majesty." After the failure of this mission an endeavour was made to remove his prejudices and to enlarge his mind by arranging for him a visit to India, in the course of which he could meet the leading administrators of the country. His acceptance of the invitation was viewed with disfavour by the more bigoted and ignorant of his subjects, but the manner of his reception by Lord Minto in Jan. 1907, and the good will displayed towards him, undoubtedly did much to improve the relations between the two governments.

By the Anglo-Russian convention signed on Aug. 13, 1907, Great Britain disclaimed any intention of altering the political status of Afghanistan, and Russia declared Afghanistan to be beyond her sphere of influence.

Habibullah, though as suspicious as his father, was more susceptible to modern influences, and among the many mixed blessings of civilization which he introduced into an unappreciative country were motorcars, telephones, newspapers, an hydroelectric scheme and the Habibia college, a high school in Kabul, the staff of which was chiefly composed of teachers from India. Many of these were regarded by the ignorant clerics of Afghanistan as inventions of the devil and the seed of infidelity, and it was partly from a sense of the antagonism which their introduction had aroused and partly with a view to conciliating the hereditary enemies of his house that Habibullah treated with great and unusual leniency the Ghilzais and Mangals of Khost, the district lying immediately to the west of the Kurram valley, who in 1912 had been goaded into rebellion by the rapacity of the local governor.

**World War I.**—On the outbreak of World War I in 1914 the amir declared his intention of abiding by his agreement with the British government and maintaining the neutrality of his country, but the entry of Turkey, the chief Islamic power, whose ruler was regarded by many Moslems as their caliph, encouraged the anti-British party in Afghanistan and induced the amir to receive a German mission, which contrived to reach his western frontier by way of Persia and entered the country as fugitives, having left in the hands of the Russians their confidential papers and that which was most likely to make them welcome in Afghanistan, their gold. They were admitted to Kabul, but their manners and bearing were not calculated to conciliate their hosts. They were regarded as state prisoners rather than as guests, and, in 1916, becoming apprehensive, on misleading information, of the amir's intentions toward them, they retired hastily from Afghanistan, and some of them, falling into the hands of the Russians, were treated as prisoners of war. Habibullah preserved his

neutrality until the end of the war, and would doubtless have received substantial recognition of his loyalty, in most difficult circumstances, to his obligations, had he not been assassinated on Feb. 20, 1919. His brother Nasrullah Khan, caused himself to be proclaimed amir, but after a reign of six days was ousted by his nephew, Amanullah, who was recognized by the nobles and people as king.

**Amanullah.**—The new ruler's position however was not secure and in May 1919 he adopted the expedient of consolidating his power by declaring war on his neighbour, Great Britain, timing his action to coincide with an expected outbreak in India. His information was faulty and his attempted invasion failed After a few weeks of sporadic fighting during which British and Indian forces occupied Dakka beyond the Khyber, and Spin Baldak opposite Chaman, the amir sued for peace which was granted in a treaty signed at Rawal Pindi on Aug. 8, 1919. By the terms of this treaty the amir lost the British subsidy granted to his predecessors, but obtained freedom from control of his relations with foreign states. He had thus secured his main objective, and fortified by the prestige accruing to him as liberator of his country, he lost no time in entering into relations with foreign governments. His envoys signed treaties with Russia (Feb. 1921) and Turkey (March 1921), while a further treaty to regulate his relations with Great Britain was signed in Kabul in Nov. 1921. Treaties with France, Italy, Germany, Iran and several minor European states followed while an envoy was despatched to Washington, D.C , to endeavour to arrange an exchange of diplomatic representation with the United States. A convention with Great Britain arranging for the free import through India of goods as well as munitions followed in June 1923. An exchange of diplomatic representation with Great Britain, Russia, Turkey, Iran, France, Germany and Italy took place, and by the end of 1923 Afghanistan may be fairly said to have joined the comity of nations.

But Amanullah's government did not prosper. The ruler himself was a headstrong reformer, and though a zealous worker he had neither the understanding nor the experience to appreciate the necessity for caution in planning the progress of his backward and fanatical people. His zeal for reforms soon brought him into conflict with his subjects. A rebellion which broke out early in 1924 in the turbulent Southern province and lasted for nearly a year showed up the weakness of his army, exhausted his revenues and severely impaired the stability of the state. Matters went from bad to worse in the years that followed. The king ignored or sent into exile his more sober advisers, neglected his army and made little or no attempt to adjust the economic affairs of his country to the changed conditions of the world in which it now found itself. His attitude toward his immediate neighbours showed that he had little appreciation of his obligations to maintain and foster good relations with the powerful states which surrounded him.

The end came shortly after his return in June 1928 from a prolonged tour of Europe and the near east. Dazzled by his experiences he attempted to emulate the reforms, the success of which he had witnessed in Turkey and Iran. A series of ill-considered measures, which included the education of women, alienated the powerful priestly class, and drove the country to open rebellion. In Jan. 1929 Amanullah was forced to flee the country.

**Habibullah Ghazi.**—The capital, Kabul, where the ill-paid army had little stomach for a fight, fell into the hands of a brigand named Bacha-i-Saqao (son of the water carrier) who took the name of Habibullah. He maintained a precarious hold over Kabul and the surrounding country, and also in Herat and the northern provinces for a matter of nine months, but was defeated and executed by Sirdar Nadir Shah in Oct. 1929.

**Nadir Shah.**—The new ruler who ascended the throne with the title of king (Ala' Hazrat) was a direct descendant of a brother of Amir Dost Mohammed and cousin of Amanullah. He had previously been commander in chief of the Afghan army, but had been in exile in France from 1924. Taking over the reins of government he was faced with a desperate situation. Apart from the few thousand tribesmen who had helped him to defeat Habibullah he had no army, the treasury was empty, Herat had formed a semi-independent administration and the tribes having once tasted of complete freedom were disinclined to submit to authority. He set to work however, ably assisted by his brothers, to bring the country under control, to remake an army and to repair the economic situation. Two serious rebellions were quelled in the first year of his reign, and in the second a formidable brigand chief was driven from the northern provinces. Aided by some timely assistance from the British government he reformed his army, and by 1932 stability was sufficiently restored to enable him to turn his attention to economic reforms. While devoting much of his time to the study of industrial development and financial equilibrium he was yet able to turn his attention to such matters as the improvement of irrigation, and the development of communications. But he had many enemies and his determination to abide by his treaty undertakings with Great Britain undermined his influence with the tribes. The party of ex-King Amanullah was active, and in 1932 a plot to foment rebellion in the Southern province was discovered The rebellion was suppressed and its leaders executed, but a year later in Nov. 1933 King Nadir was assassinated by the son of one of them, a student at the German school in Kabul.

**Zahir Shah.**—The accession of the new king who was the son of Nadir Shah and 19 years of age at the time of his father's death was accomplished without difficulty, chiefly owing to the support afforded him by his uncles, the prime and war ministers After a brief pause while the country recovered from the shock of Nadir's death, the task of prosecuting the plan of reconstruction laid down in the previous reign was resumed. While the greatest care was taken not to incur the charge of unorthodoxy which had caused Amanullah's downfall, the general line of policy provided for the material and moral advancement of the country toward a more civilized way of life. Economic measures took a prominent place. Industrial development was ensured by means of long term credits negotiated chiefly with Germany for the purchase of machinery and the construction of factories. Considerable quantities of munitions were purchased from Europe. Education was developed by the establishment throughout the country of primary schools.

Relations with foreign countries continued satisfactorily, though fear of communist penetration was always latent, and with Britain some friction was manifest over border disturbances, connected particularly with a notorious firebrand, the Faqir of Ipi.

In 1934 Afghanistan joined the League of Nations, and in 1937 close association with Turkey caused her to become a signatory of the Sa'adabad pact. Japan, the United States, Iraq and Egypt established legations in Kabul.

In 1937–38 disturbances among the powerful Ghilzai clan caused some anxiety to the government, but the country as a whole under the wise direction of the prime minister, Sirdar Hashim Khan, was progressing peacefully when in 1939 war broke out in Europe.

**World War II.**—Afghan economic dependence on Germany and her reluctance to be drawn into a distant conflict which did not appear to concern her caused Afghanistan to declare neutrality in Sept. 1939. This policy was rigidly followed till Oct. 1941 when on the advice of Great Britain and Russia the Afghan government decided to remove all Axis nationals, except members of diplomatic missions, from the country. This departure from neutrality which was ratified by the Great Assembly (*Loe Jirga*) was accompanied by a renewed pronouncement of Afghan determination to maintain in future her neutral status. This determination was unchanged at the close of the European phase of the war with the result that Afghanistan was one of the few states to whom invitations were not issued to take part in the international conference to establish a world security organization which opened at San Francisco on April 25, 1945.

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**AFGHAN LANGUAGE:** *see* PUSHTU.

**AFGHAN TURKISTAN,** province of Afghanistan, bounded east by Badakshan, north by the Oxus river, northwest and west by Russia and the Hari Rud river, and on the south by the Hindu Kush, the Koh-i-Baba and the northern watershed of the Hari Rud basin. It is 500 mi. long, northeast to southwest, and averages 114 mi. in width between the Russian frontier and the Hindu Kush. The area is about 57,000 sq.mi.—two-ninths of Afghanistan. The population is about 800,000, mainly cultivators in towns and villages, the chief being Mazar-i-Sharif (30,000), the modern supplanter of Balkh. The lowland has much loess and the riverine lands of the Oxus are highly cultivated, but to the west the Turkoman area is waste, and to the south are rough mountains. The people are Persian and Uzbeg with Turkoman, Hazara (Mongol) and Hindu elements. Ancient Balkh or Bactriana belonged to the Achaemenian empire. About 250 B.C. Diodotus (Theodotus), governor under the Seleucidae, made himself independent and founded the Graeco-Bactrian dynasties which succumbed to Parthian and nomad movements about 126 B.C. The succeeding Buddhist era has left us huge sculptures at Bamian and the rock-cut topes of Haibak. Jenghiz Khan laid waste the land; later it belonged for a century to the Delhi empire, then became Uzbeg, and in the 18th century came under Ahmad Khan and his son Timur (Durani Afghans). Next the Khanates fell apart during strife between Timur's sons, and the Uzbeg khans came under the rule of Bokhara. Under Dost Mohammed (1850–1859) the Afghans occupied the province, and boundary disputes were settled (1873) by the Anglo-Russian agreement awarding Andkhui, Shibarghan, Saripul and Maimana to Afghanistan. The Russo-Afghan commission delimited the boundary in 1885.

**AFIUN QARAHISAR** or AFYON KARAHISAR, popular name of Kara-hissar Sahib, the chief town of a vilayet in Asiatic Turkey, nearly 200 mi. east of Smyrna, and 50 mi. south-southeast of Kutaiah. Pop. (1940) 25,897. Called Nicopolis by Leo III after his victory over the Arabs in 740, its name was changed by the Seljuk Turks to Kara-hissar. It stands partly on level ground, partly on a declivity, and above it rises a precipitous trachytic rock (400 ft.) on the summit of which are the ruins of a Byzantine castle. The town is an important centre of trade. Opium in large quantities is produced in its vicinity and forms the staple article of its commerce; and there are, besides, manufactures of black felts, carpets, arms and saddlery. Afiun contains several mosques (one of them a very handsome building). The town is connected by railway with Smyrna, Konia, Angora and Istanbul.

*See* V. Cuinet, *Turquie d'Asie* (Paris, 1894), vol. iv.

**A FORTIORI** (Lat. "from a stronger [reason]"), a term used of an argument in which the conclusion is supported by a ground that is stronger than another that has already been accepted, or is commonly accepted, as sufficient justification for asserting the predicate of the conclusion of that kind of subject. For example, if in a right-angled triangle the side opposite the right angle must be greater than either of the other sides (because the right angle is greater than either of the other angles), "how much more so" (*a fortiori*) must this be the case in an obtuse-angled triangle (which is even greater than a right angle).

**AFRANIUS, LUCIUS,** Roman general, lived in the times of the Sertorian (79–72 B.C.), third Mithridatic (74–61 B.C.) and Civil Wars. In 60 B.C., chiefly by Pompey's support, he was raised to the consulship. In the following year, while governor of Cisalpine Gaul, he obtained a triumph, and on the allotment of Spain to Pompey (55 B.C.), Afranius and M. Petreius were sent to govern it as legates. On the rupture between Caesar and Pompey they were compelled, after a short campaign in which they were at first successful, to surrender to Caesar at Ilerda (49 B.C.), and were dismissed on promising not to serve again in the war. Afranius, however, joined Pompey at Dyrrhachium, and at the battle of Pharsalus (48 B.C.) had charge of Pompey's camp. Despairing of pardon from Caesar, he went to Africa, and was present at the disastrous battle of Thapsus (46 B.C.). He was afterwards taken prisoner and handed over to Caesar, whose veterans put him to death.

*See* Hirtius, *Bell. Afric.*, 95; Plutarch, *Pompey;* Dio Cassius xxxvii., xli.–xliii.; Caesar, *B.C.* i. 37–87; Appian, *B.C.* ii.; CAESAR and POMPEY.

**AFRANIUS, LUCIUS,** Roman comic poet, flourished about 94 B.C. He dealt chiefly with everyday subjects from Roman middle-class life, and tells us that he borrowed freely from Menander and others.

*See* Horace *Epp.* ii. 1.57; Cicero, *Brutus*, 45. *de Fin.* i. 3; Quintilian x. 1. 100; fragments, about 400 lines, in Ribbeck *Scaenicae Romanorum Poesis Fragmenta*, ii. (1898).

**AFRICA,** the name of a continent which is the largest of three great southward projections of the main land-mass of the earth's surface, joined to Asia by the isthmus of Suez, 80m. wide. From its northern extremity, Ras ben Sakka, a little west of Cap Blanc in 37° 21′ N. to the southern, at Cape Agulhas, 34° 51′ 15″ S., it is about 5,000m. long while west to east it is about 4,600m. from Cap Verde, 17° 33′ 22″ W., to Ras Hafun, 51° 27′ 52″ E. Length of coastline is 16,100m. for a mainland area of 11,262,000 square miles.

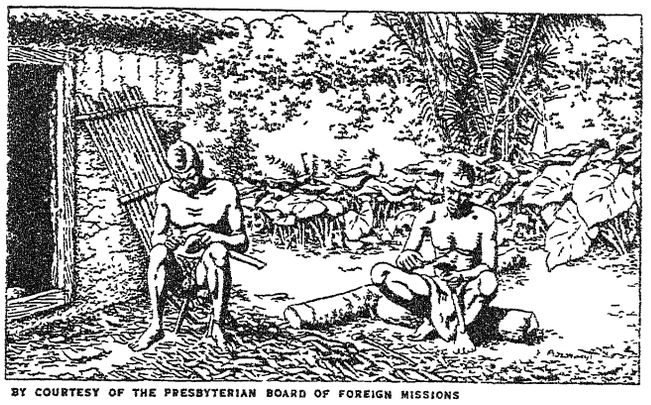
## GEOGRAPHY

Africa is largely a plateau, broken and elevated in the south and lower towards the north, with fold mountains adhering to the northern flank, and it thus contrasts very strikingly with Euro-Asia in which fold mountains of successive series in diverse stages of denudation occupy a large proportion of the surface. The mean elevation of Africa is about 2,000ft., that of Asia 3,117ft. Asia has much quite low as well as very high land. Africa, as a plateau, has little at either extreme and in particular the land over 10,000-ft. in Africa is merely small groups of peaks.

The high southern part of the plateau reaching north almost to lat. 10° S. has sharp slopes around its edges on the west, south and east, with a narrow coastal plain below, broadening in the north-west and especially the north-east in Angola and Portuguese east Africa respectively. Towards the south this plateau has a high rim, over 6,000ft. above sea near Windhoek in the west and in Basutoland on the south-east. The southern edge is stepped, with the Nieuwveld range above the Great Karroo, the Little Karroo as the step next below and the coastal plain next below that. Within the high rim are considerable areas of centrally placed lower land, the South Kalahari in the south, the depression draining into Lake Ngami (now practically dry) and the Barotse-land depression, but all keep above the 1,500ft. contour and each is a local depression in a table-land most of which is at more than 3,000ft. above the sea. Generally speaking the plateau-edge dips down, with a small coastal ledge, into fairly deep water, but towards the Cape of Good Hope there is a fair area of shallow water off-shore.

The steepness of the edge of the plateau is important as a determinant of the character of the rivers, long sections of which flow in deep slots cut back into the plateau from its edge. The Orange river is fed from the rains that fall on the Drakenberg range and flows west through lands of drought; the Limpopo and Zambezi, the two largest on the east flow out to the broad sandy alluvial flats of Portuguese East Africa and the slot-like character

of a large part of the Zambezi-channel is generally known from the occurrence of the famous Victoria Falls in the south-west the Zambezi system interlaces with that of the Taukhe or Tioghe and receives surplus water from it at times. The rest of the Taukhe water loses itself in the swamps and saltpans of the former Lake Ngami basin. The lower parts of the three great rivers have contributed to the lowering of considerable areas of the plateau below the 3,000ft. level. The Zambezi river, about 2,000m. long, drains an area of half a million square miles, the Orange river, about 1,300m. long and with a drainage area of about 170,000sq.m. but more than that amount must be added if we define the basin orographically and so include in it larger waterless tracts. Towards the north this southern plateau tends to run rather higher and there is a continuous belt of highland across the continent from the coastal plain on the west to Lake Nyasa on the east, in which region the typical form of the southern plateau is interfered with by important rifts to be considered next. Allowing for complexities the southern plateau of Africa is thus essentially an elevated surface with still higher edges for the most part and with, also, considerable depressions, usually desertic in character, near the median north to south axis of the plateau. North of this southern plateau, on the west, is the basin depression, largely floored by younger rocks and now occupied by the Congo and its numerous feeders. The basin is almost enclosed by land over 1,500ft. in height, for the main river escapes through a deep cut between the hills out to sea; there is general agreement that the basin is a depression in the original plateau surface that has been an inland sea. To the east of the basin are series of physical features that together constitute one of the major physical problems of the earth's surface. They are collectively designated the Rift valley system and have been the subject of much discussion, for which reference may be made especially to the files of the Geographical Journal (London, especially 1916–21) and to Krenkel *Geologie Afrikas* (1925). In this region in later tertiary and early Pleistocene times great movements occurred and earthquakes are still a feature. Often a block has sunk between parallel fractures and thence has come the name of Rift valley. A western rift may be traced from Lake Nyasa via Tanganyika and Lake Albert to Gondokoro. Many of the fractures run either north-west to south-east (the so-called "Erythraean" direction) or, in the north, north-east to south-west (the "Somali" direction). A middle rift line goes north-north-east from Nyasa via Lake Naivasha to Lake Rudolf, with branchings and changes *en route;* though its general direction is north to south, its component fractures are generally north-west to south-east and north-east to south-west, with some north to south ones in the north. The easterly rift line is less important and goes on the whole north-eastwards from about the middle of Lake Nyasa. In the floors of the rifts lie the long narrow lakes, Nyasa 1,645ft. above sea-level but with a maximum depth of 2,580ft. so part of its floor is over 900ft. below sea-level, Tanganyika, also very deep and normally 2,624ft. above sea-level but this level is so variable that the outflow from Tanganyika is quite intermittent, and Rudolf at only 1,180ft. Some other lakes are small; that of Naivasha is over 6,100ft.



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

NATIVES OF WEST AFRICA ENGAGED IN MAKING SPOONS IN THEIR TRADITIONAL MANNER

Many portions of these lakes have sharp walls and are obviously filling depressed zones. The western rift is the youngest and sharpest; the most important movements may have been as late as the Pleistocene period. The rifts all show volcanic activity which is most marked along the eastern sides of the middle one, where occur the great peaks of Kenya (17,007ft) and Kilimanjaro, on which Kibo peak (19,321ft.) has long been held to be the culmination of Africa but Nilsson (1927) claims to have found points on Kilimanjaro 13ft and 17ft. higher, respectively, than the highest previously known. Ruwenzori, on the eastern side of the western rift is 16,794ft high and has a block structure apparently with faulted sides; interestingly enough it is in about the same latitude as the other great peaks mentioned and they are all on a belt of land, higher than most of the flanking territory, that stretches from the volcanic Cameroons (*v. inf*) to the east coast. This cross-line scheme is noticeable in great basins (Niger, Chad and Bahr-el-Ghazal) to the north-west and is evidently of some importance in the story of the deformations that Africa has undergone.

It seems clear that at Lake Albert there was faulting on a large scale both before and after the country was arched up into a wrinkled dome while, farther east, the middle rift may be connected with faulting near the median axis of a long arch. Faulting of domed and arched structures, supplemented by vulcanicity on a large scale, both occurring so recently as to leave features extremely sharp, are thus the characteristics of the country. Between the arched areas of Lake Albert and the middle rift in a downfold lies Lake Victoria of area approximately 26,000sq.m. and more or less rectangular but fractures determine only a small part of its outline and its shores are not high-cliffed. Unlike the rift lakes, it is less than 50 fathoms deep. It is at 3,720ft. above sea-level.

It is well known that the zone of fractures extends northwards marking the east and west edges of the Abyssinian highland, the series of cliff lines bordering the Gulf of Aden and the Red Sea, and the rift lines along the Gulf of Aqaba to the Dead Sea and the Jordan valley. All through this zone one finds systems of parallel fractures and a considerable number are north-west to south-east, others are north-east to south-west, others apparently north to south.

The relations of land and water, both inland waters and the ocean, have naturally varied a lot with the great changes of land levels, but apparently since present levels were reached, and therefore probably well on in the Pleistocene period, lakes of immense size existed in the rift valleys of East Africa. Shore lines 600ft. above present water-levels have been traced over long distances and there is not much doubt that during the major glacial phases of the Pleistocene ice age in Europe the mountains of East Africa were glaciated much farther down than at present.

The northern extension of the rift system to Lake Rudolf and beyond it north-westwards to the lowlands of the White Nile divides east Africa from Abyssinia and Somaliland. The latter is a plateau sloping south but broken sharply on the north, where a steep slope marks the coast of the Gulf of Aden, and less sharply on the south-east to the Indian Ocean as well as on the south-west towards the Juba river basin which may be described as a widening of the coastal plain. Socotra is essentially a broken off projection of Somaliland. Abyssinia on the other hand is a remarkable mountain land bounded east and west by great fractures of remarkable sharpness giving steep cliffs down to the Red Sea and to the White Nile lowland. The rift system of the Red Sea and that of the Gulf of Aden both enter into relationship with an Abyssinian rift which runs from the sea to Lake Rudolf and divides Abyssinia from Somaliland. Abyssinia differs entirely from any folded mountain range; it is a high and deeply dissected block full of evidences of volcanic activity and provided with powerful rivers, feeders of the White Nile (Sobat, etc.) the Blue Nile and the Atbara, indicating its high (largely summer monsoonal) rainfall. It lies for the most part more than 5,000ft. above sea-level and reaches up to nearly 15,100ft. at Ras Dashan in the north. Lake Tana (Tsana) in the highlands is actually 5,690ft. above sea-level.

The Nile may be said, in a way to begin as the Kagera, the chief feeder of Lake Victoria. It leaves that lake on the north and after passing through the lake swamp of Kioga it goes to the north-eastern end of Lake Albert. Issuing again from the northern end of that lake, it emerges in due course from the rift system into a great flat area less than 1,500ft. above sea-level and framed by higher land save in the north-east and giving so little fall on the river that it becomes obstructed by floating vegetation. It is noteworthy that this upper Nile basin, the Lake Chad basin and the main Niger basin, all more or less enclosed, are nearly in the same latitude, with the still more enclosed basin of the Congo to the south. Basins of this kind are thus a marked feature of the geography of the old block of Africa. After the Nile (Bahr-el-Jebel) has received the Sobat from the east it flows north through increasingly barren country into a slot cut in the great desert. The transition from the fertile slot up the, often steep, slope to the desert plateau is a very sharp one and the river has no tributaries in its desert section. It thence follows that, though the Nile is 4,000 mi. long from the Kagera source to the sea, its basin-area is only 1,107,227 sq.mi., whereas the Congo, rather under 3,000 mi. long but very rich in tributaries, has a basin area of about 1,425,000 square miles.

North of the Congo basin one may go from the Gulf of Guinea across to the extreme east without touching a point less than 1,500ft. above sea. This rise or swell of the land surface has, on its north-west border, the high line (north-east to south-west) of the Cameroons, apparently an old mountain structure rejuvenated by volcanic outpourings. On this line stands the great peak of the Cameroons (13,370ft.) at the corner of the Gulf of Guinea, and it is continued into the sea giving the island of Fernando Po (Spanish) and those of S. Thomé and Principe (Portuguese). On Fernando Po, Clarence Peak is over 9,000ft. high.

North of the Gulf of Guinea the land soon rises above the 600ft. level and towards the west there is a fairly marked slope up from the sea to over 1,500ft. above its level, the slope faces south-west and above it towards the north is a patch above 3,000-ft. in height while one small area near the northeast border of Liberia reaches nearly 10,000ft. This region, with a heavy, monsoonal, summer rainfall is the birthplace of the feeders of the Niger. Thence that river flows north-east demonstrating the general slope of the land down to the Sudan and Sahara, then east and south-east and south to reach the gulf in the lowland between the eastern end of the West African coastal edge and the highland of the Cameroons. Its length is about 2,600m. and basin-area about 800,000 square miles.

Between the main Niger basin and that of the Bahr-el-Ghazal and White Nile lies a basin of internal drainage with the shallow, shrinking Lake Chad in its southern half and a depressed area with some swamps in the north-east. Lake Chad is about 850ft. above sea-level, and receives drainage from the south-east and west. The other depressed area is, in parts, less than 600ft. above sea but the drainage to it is of very small account. North of the Niger and Chad basins is the immense arid belt of the Sahara. It reaches the Atlantic along a low practically waterless coast 1,000m. long from the mouth of the Senegal to the streams of the Atlas. The western part of the Sahara is generally low and has no heights reaching 1,500ft. but in the northern centre is the Ahaggar plateau, connected with the eastern end of which are north-west to south-east lines of higher land one going north-west to the Gulf of Qabes and one south-east crowned by the Tibesti highlands. Eastward, heights diminish again but there is practically a continuous cliff edge along the Nile slot on both sides and the continuation of the desert plateau on the east stands for the most part more than 1,500ft. above sea with a considerable area over the 3,000ft. line.

The desert has large sandy areas especially in the west with regions of stony desert (*hammada*) in the northern centre and a good deal of stony desert to the east. A number of oases break the monotony of the desert, some being north of Lake Chad; some of the land around the Tibesti highland (reaching 8,000ft.) also gets more moisture and has a population aggregated in certain centres. Wadis from the Ahaggar plateau and elsewhere in the desert are interesting evidences of a former greater rainfall and from a study of animal remains as well as of finds of human implements it seems that the Sahara was more or less a grassland during some phases at any rate of the early ages of man. The probability is that periods of greater rainfall in the Sudan more or less coincided with periods of Pleistocene glaciation in Europe The desert area is estimated at 3,500,000 square miles. The Nile slot cuts the desert without modifying it appreciably, and opens out north to the famous delta west of which the coast is not high save in the Barca or Cyrenaica plateau which reaches 1,500ft. not far from the sea.

The Atlas range, the north-western part of the continent, is orographically a part of the mountain arcs that frame the basins of the western Mediterranean. It reaches a height of 14,000ft. at Bu Uriul and Ari Aiaschi and runs, generally, east-north-east to west-south-west. The eastern half has the Tell Atlas on the north and the Sahara Atlas on the south side with the plateau of the Shotts, several lakes without outlets, between them. The western region has the Mid Atlas continuing the first and the Great Atlas continuing the second; the Anti Atlas is parallel to and south of the Great Atlas. To the north of the Mid Atlas the separate coastal mountain range of Er Rif curves north-west to the Strait of Gibraltar beyond which the curved high line is continued in the Sierra Nevada of southern Spain.

South of the eastern ends of these highlands is a more or less east to west line of low land containing the Shott el Jerid (about 52ft. above sea-level) and the Shott Melrir (nearly 100ft. below sea-level) both without outlet. Africa is remarkable for the extent of land, 3,750,000m. in basins of inland drainage.

Africa is singularly poor in islands. Madagascar 229,820sq.m., is one of the large islands of the world (smaller than New Guinea and Borneo); it is separated from Africa by the rather deep Mozambique Channel and in structure it resembles Africa. Biologically it has links both with Africa and with the East Indian archipelago. Socotra, east-north-east of Cape Guardafui, a continuation of the Somaliland plateau is the only other African island of any size. The Canary and Cape Verde archipelagoes of the north-west and the Comoro archipelago of the east are volcanic (but pebbles of continental, or plutonic, material have been sent to Europe from Anjovan, one of the lesser Comoro Islands); the Seychelles are a continental remnant. There are coral islets between the Comoros and the Seychelles. Mauritius, Reunion and Rodriguez, the two last entirely, the first mainly volcanic, lie in the Indian Ocean east of Madagascar; Ascension, St. Helena and Tristan da Cunha in the south Atlantic far to the west. (X.)

## CLIMATE

Extending from latitude 37° N. to 35° S., the greater part of Africa lies within the tropics, and except on mountains and plateaux the average annual temperature is high, ranging from 62° at Cape Town to 86° at Massaua on the Red Sea. On the other hand there are great extremes of rainfall; in the Egyptian desert appreciable falls occur only once in a number of years, while the western slopes of the Cameroon mountains are among the wettest parts of the world, Debundscha at the foot of Cameroon Peak having an average of 369in. a year. Africa may be conveniently divided into five climatic divisions, of which four run roughly parallel with the lines of latitude, while the fifth occupies a large part of the eastern coastal districts. On either side of the equator is a belt of heavy rainfall which is distributed fairly uniformly throughout the year, but with a tendency for April and October to be the wettest months, those following the annual passage of the sun across the equator. This belt roughly coincides with the Congo valley and Gabon. Northwards the first rainy season is retarded into May and June, while the second rainy season is advanced into September and August, giving a long dry season, a principal wet season, a short dry season and a secondary wet season which is not much inferior in intensity to the first. In latitude 8° or 9° N. these two rainy seasons coalesce into one wet season lasting from May or June until September, while the rest of the year is dry; at the same time the total rainfall decreases. North of 15° N. the rainfall is small and irregular and

we pass into the belt of desert which includes the Sahara and Sudan. This extends to the Mediterranean in the north-east, but in the north-west there is a coastal strip in Algeria and Morocco which has a long dry summer but an appreciable winter rainfall and forms part of the Mediterranean climatic province.

In South Africa there is a similar succession, the April rainfall maximum of the equatorial belt advancing into March and February, while the October maximum is retarded into November and December, until the two coalesce into the summer rainfall region of the southern hemisphere, which includes Angola and southern Rhodesia. South of this is the Kalahari desert, the counterpart of the Sahara, while in the extreme south-west is a small area round Cape Town with a dry summer but appreciable rainfall in winter (April to September). This zonal division does not apply to eastern Africa south of the equator, which has summer monsoon rains and a winter dry season over its whole extent.



BY COURTESY OF THE AMERICAN BOARD OF FOREIGN MISSIONS

A RAIN-MAKER, AN IMPORTANT MEMBER OF WEST AFRICAN COMMUNITIES, WITH THE REQUISITES OF HIS MAGIC

**The Equatorial Rainfall Belt.**—This region includes the greater part of the Congo basin above Leopoldville, Gabon, Cameroon and the coast of Nigeria as far as the mouth of the Niger. Its characteristics are uniformly high temperature and humidity, a large amount of cloud and a rainfall generally exceeding 60in. a year and rarely falling below 2in. in any month. The temperature is rarely extreme, and probably many parts of the region have never reached the Greenwich maximum of 100°, but on the other hand the temperature rarely falls below 60° on the low ground. The annual average may be taken as 80°, rising to 87° during the day and falling to 73° at night. The hottest months generally fall in the early part of the year, while July and August tend to be coolest, but the annual range is rarely as much as 10°. The relative humidity averages 80%, and this continual moist heat is very enervating to Europeans. The greater part of the region is densely forested.

**Savanna Belts.**—North and south of the equatorial rain forest is a zone of moderate rainfall, the whole of which falls in a short summer rainy season, while the remainder of the year is dry. These belts may be regarded as extending as far as the isohyet of 20 inches. The northern belt includes Senegal, Bathurst, Sierra Leone, the Gold Coast, Dahomey, the greater part of Nigeria, the Sudan and Abyssinia. The rainfall varies greatly, rising to as much as 154in. a year at Sierra Leone, but even there the months of December to March are almost rainless. The drier parts are occupied by open grass-land but the wetter areas are forested. The rainy season from May or June to September inclusive, in spite of being summer in the astronomical sense, is the coolest part of the year, the temperature being kept down by the great cloudiness and heavy rainfall. This season is unpleasant because of the high humidity, the small daily range of temperature and the frequent thunderstorms and tornadoes, especially at the beginning and end of the season. The prevailing wind is south-westerly at the surface, but is very light; at a height of a few thousand feet the wind becomes north-easterly, and the thunderstorms advance from the north-east. From late October until the end of February is the most pleasant season, with hot days but cool nights, dry air and clear skies; the prevailing wind is north-easterly except on the coast, where sea-breezes occur during the day. Over the interior the wind is often laden with penetrating fine dust (Harmattan wind). In March, April and the beginning of May, the temperature is very high, maxima sometimes exceeding 100° even on the coast, and reaching 110° in the interior. The humidity of the air is still low but is rising steadily, and the wind is light and variable. The rainfall of the Abyssinian plateau is of great importance as the source of the annual Nile floods, and so of the fertility of Egypt. The annual rainfall of Addis Ababa averages 50in., but more than three-fifths of this amount falls in July, August and September, while October to January inclusive are almost rainless. In spite of the position of Abyssinia near the eastern margin of Africa, it is believed that most of the moisture which falls as rain is derived from the Atlantic ocean, and is carried across the whole width of the continent by the south-west winds, and that only a comparatively small part of the rainfall is derived from the Indian Ocean. The southern savanna belt includes Angola and Rhodesia; the climate is generally similar to that of the northern belt, but the summer rainy season occurs from December to February The rainfall nowhere exceeds 60in. and owing to the generally high elevation the climate is comparatively pleasant and healthy The amount of cloud is comparatively small, and the lowest temperatures occur in winter and not, as in the north, in the rainy season.

**Deserts.**—The greater part of Africa north of 16° N. is occupied by an arid climate which gives rise to the deserts of the Sahara and Egypt. The rainfall is less than 10in. a year, and over a large part of the area is probably less than an inch, being confined to a few drops once or twice a year and isolated heavy falls at intervals of many years; under these conditions the term "average" has no meaning The temperature is very high in summer, the average in July exceeding 90° over a large part of the interior; it remains very hot from April to September inclusive, but the winter months are relatively cool. The daily range of temperature is very great, exceeding 30° at many places; for example at El Obeid in the Anglo-Egyptian Sudan in January the mean daily maximum is 86° and the mean daily minimum 52°, and frosts are occasionally experienced. Very high maxima are recorded in summer, exceeding 110° on the coast and 120° in the interior, while at Azizia, in Tripoli, a shade temperature of 136° has been recorded, the highest known on the earth's surface. The air over the interior is dry, less than 40% average humidity for the year, and figures of 2 or 3% have been recorded. On the coast special conditions prevail, which will be referred to later. The amount of cloud is very small, generally less than one-fifth of the sky covered, while in parts of the Egyptian desert no cloud is seen for months together. The winds are generally light and irregular over the Sahara, but dust storms, sand pillars and other local violent winds occur. In the Nile valley the prevailing wind is southerly from November to February and northerly from April to September and reaches considerable strength in the midsummer months, greatly moderating the temperature; occasional very hot, dry, dust-laden southerly winds are known as the Khamsin; these are very unpleasant, especially when accompanied by sand storms Similar winds from the desert occur also under local names in Tripoli, Tunis and Algeria; they frequently cross the Mediterranean to southern Italy as the scirocco. A severe form is the dreaded simoom or samun, a hot blast of air (125° or more), often accompanied by heavy clouds of dust or sand. Land and sea breezes are well developed on the coast of Tripoli, Tunis and Algeria, but not of Egypt. The corresponding desert of southern Africa, the Kalahari, is of much less extent, being limited to the western half of the continent, and the heat and dryness are not so excessive as in the Sahara.

The climate of the coast of the Red Sea and Gulf of Aden is peculiar. The rainfall is exceedingly scanty, the sky almost cloudless, and the temperature very high, but this is associated with an abnormally high humidity, the moisture being derived from the warm waters of the Red Sea, which reach 90°. The highest known temperature of the wet-bulb thermometer, 100°, has occurred at Kamaran island and Berbera; this moist heat is very unpleasant. Where the Sahara and Kalahari meet the Atlantic, different conditions occur; here the presence of cold currents makes the surface of the sea very cold, while the land a few miles inland is very hot; these regions have a very small rainfall, clear skies but frequent fogs over the sea, and a moderate temperature which changes very little throughout the year. The rainfall of the South African west coast from 17 to 28° S. is less than an inch a year.

**Mediterranean Climate.**—Morocco, northern Algeria and northern Tunis have pleasantly mild, rather rainy winters and

long, hot, dry, almost cloudless summers. The annual rainfall averages about 30in., but is very variable. The mean temperature is between 50° and 60° in January and about 80° in July and August; the daily range is about 15°. A similar climate is found over a small area near Cape Town, which has a temperature ranging from 55° in July to 70° in January and February, and a rainfall of 25in. falling mainly from May to September inclusive.

**Eastern Africa.**—Kenya Colony, Tanganyika, Uganda, Nyasaland and Portuguese East Africa have an equable climate with a temperature between 75° and 80° near sea-level and a rainfall of 30 to 60 inches. There is generally a fairly well-marked rainy season; near the equator this occurs in April and May with a minor rainy season in November and December, but further south there is only one rainy season, falling in summer. Thus at Zanzibar the rainiest months are April, May and November, in that order, and at Nairobi, April, November and May, but at Lourenço Marques in 26° S., January and February. The dry season or seasons are not so extreme as in West Africa; months entirely without rain are rare and the relative humidity remains fairly high throughout the year. The prevailing winds are easterly. Thunderstorms are very frequent during the rainy season, recurring with great regularity almost every afternoon. The low-lying coastal areas are enervating and in places unhealthy, but large parts of the interior, including the whole of Uganda, form plateaux with an elevation of several thousand feet, and as the average temperature decreases upwards at a rate of about 3° per 1,000ft., these uplands are much cooler and more bracing than the coastal regions, while their distance from the sea makes them somewhat drier except on slopes directly exposed to the rain-bearing easterly winds. These plateaux are rather more suitable for European habitation than the coastal areas. Natal and the eastern parts of the Cape Province have warm, rainy summers, with a temperature of 70° to 75°, and moderately cool winters, relatively dry but very seldom rainless. The annual rainfall is between 30 and 40in.; the average July temperature is 63° at Durban and 59° at East London, but over the high ground of the interior frosts are sometimes experienced in winter. This is one of the finest and healthiest climates in Africa. (C. E. P. B.)

## FAUNA

Africa, together with the Deccan and West Australia as well as Brazil, forms part of the old continental mass of Gondwanaland, whatever view one may take of the process of separation of each from the others. Gondwanaland seems to have persisted through much of the Mesozoic era, during which these southern lands were separated from the northern ones by the broad sea of Tethys, along which later uprose the great fold mountain ranges that stretch from the Pyrenees to the Malay. The southern lands thus show resemblances in their forms of life that are due to these old links. Another factor of the history of life within them is the stability of their conditions as contrasted with the wide variations that have occurred in the orography and climate of the northern lands. Those wide variations have been reflected in evolutionary changes among living things and thus the northern lands have become in a large measure the homes where new forms are born, while the southern ones are largely refugees of early strays from the north, or places where certain types immigrating since connections were made have had a great career. The Sahara desert-barrier is largely a modern (post-glacial) hindrance to immigration of animals, the Rift system a partial but serious hindrance also relatively recently established.

The isolation of Africa is far less than that of Australia, and, whereas Australia retains the two lowly egg-laying mammals (*Ornithorhynchus* and *Echidna*) and is the great home of the marsupials, and of no other truly native mammals save bats, an indication of its long separation, Africa retains neither the egg-laying mammals nor the marsupials. The lowliest order of truly placental mammals, the so called Edentata, absent from Australia, occurs in South America, Africa and south-east Asia. Its great home is South America, but the aardvark (Cape ant-eater) is peculiar to Africa and *Manis* (the scaly ant-eater) has species both in Africa and in south-east Asia. It is an interesting fact that the order, though an ancient one is absent from Madagascar. The primates offer a contrasted distribution. Among them the lemurs are ancient forms of known fossil from the northern lands but now surviving in Africa, Madagascar and south-east Asia; Africa has many more forms than south-east Asia and Madagascar many more still. From the lemurs have descended monkeys and apes; the platyrrhine monkeys are American, the catarrhine, African and Asiatic, including, among anthropoid apes, the orang-utan and the gibbon of south-east Asia and the gorilla and chimpanzee of intertropical Africa. It is generally thought that the survival of lemurs in Madagascar is a result of its separation from Africa before the great carnivores had spread thither. The absence of elephants, rhinoceros and anthropoid apes from Madagascar is noteworthy. The most important African carnivore is the lion, also found in parts of Arabia, Persia and western India and formerly more generally distributed in south-west Asia and north-east Africa until man restricted its range. The leopard (panther) and hyena are the other large carnivores. Madagascar has very primitive carnivores only, one of which was formerly said to be closely related to a West Indian form though the resemblances seem better interpreted by the fact that both are ancient types. The African elephant is a species distinct from the Indian one; the distribution of the genus was of course far wider until postglacial times. The hoofed animals of Africa are of some interest. Of even-toed forms Africa alone preserves the hippopotamus which ranged widely in northern lands until a late phase of the ice age; remains of a small hippopotamus species have been found in Madagascar which also possesses a river hog (*Potamochaeros*). It is thought that they may have swum across from Africa before the separation between continent and island became very marked. The giraffe and okapi are another family of hoofed animals found in East Africa only. The rhinoceros has east African and south-east Asiatic species. The single humped camel is now a feature of the steppes and deserts of north Africa but only as a domesticated animal introduced from Arabia. Deer are absent from Africa save for a few forms in French Africa, north of the Sahara, just as bears and wolves do not occur south of the desert. On the other hand the immense warm African grasslands are overrun by many antelopes, and the zebra and formerly the quagga. Africa thus, along with a number of old fashioned forms has several relatively new fashioned ones, but the absence of true cattle, pigs, goats, sheep and camels until man brought them is a striking fact. Of the genus *Bos*, nevertheless, South Africa possesses a representative in the Cape buffalo (*Bos caffer*). Africa has many birds peculiar to it but we need only notice the ostrich family of birds that run over grassland and desert border; extinct running birds of great size (*Aepyornis*) lived in Madagascar apparently not very long ago. Some African reptiles (*e.g. Amphisbaena*) appear closely related to South American forms, others to those of northern lands, the abundance of crocodiles is a feature and so are the chameleons, which especially abound in Madagascar. The python and puffadder are notable among African snakes. Monitor lizards, abundant in Africa and elsewhere, have not reached Madagascar. The Amphibians of Madagascar include several species also found in south-east Asia and this may be a result of an ancient land connection, and analogous arguments could be given concerning the land snails. Africa has the disastrous fate of being the one home of the tse-tse fly. (X.)

## FLORA

The character of the vegetation of Africa is largely determined by the distribution of heat and moisture coupled with the great range in altitude. Phytogeographically the continent may be primarily divided into three sections: (1) a northern extratropical region, bordering the southern shores of the Mediterranean and gradually fading into the northern Sahara desert with a very scanty flora; (2) a tropical African region, bounded approximately on the north by the Tropic of Cancer; and (3) a South African region, reaching as far north as the Limpopo, Lake Ngami and southern Angola. According to Thonner (*Fl. Pl. of Africa*, 1913), there are in Africa about 3,712 genera and over 40,000 species of flowering plants, a number constantly being added to.

**The Northern Area.**—The northern area contains a considerable proportion of genera and species common to the south of Europe, besides a large number of endemics in and south of the Atlas mountains and in Morocco. In the Atlas mountains the Atlantic cedar (*Cedrus atlantica*) is a characteristic tree, and is very closely related to species in Asia Minor and the western Himalayas, some authorities having considered them all to be forms of one variable species. The flora of Morocco is related to that of the Canary islands, whilst the somewhat meagre indigenous vegetation of Egypt is largely the same as that of Palestine and Persia.

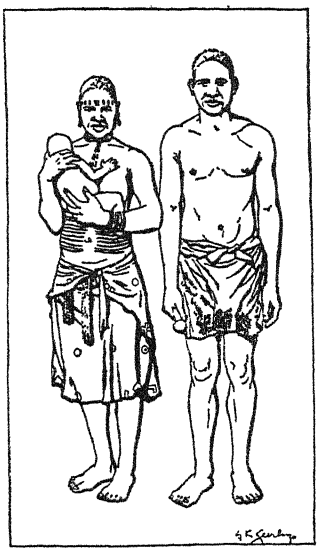
The tropical African flora may be roughly divided into four regions: (1) a northern desert or semi-desert region; (2) a savannah region; (3) a high mountain region; and (4) the tropical rain forest. The first type is characterized by a very scanty rainfall, and its flora consists largely of plants which are short-lived, such as annuals, or those specially adapted to resist long periods of drought. These include the date-palm (*Phoenix dactylifera*) which grows where other vegetation is practically non-existent. The transition from the semi-desert to that of the savannah is usually gradual with an increase in annual rainfall and pronounced wet and dry seasons. In the savannah the low, thorny bushes of the desert are replaced by scattered trees and shrubs, giving the country a park-like appearance, with an undergrowth of grasses and herbaceous flowering plants, including numerous annuals and species with underground root-stocks. This vegetation is typical of the elevated plateau-region which occupies a large portion of the continent. Characteristic trees are the baobab (*Adansonia digitata*), the shea butter tree (*Butyrospermum Parkii*), *Anogeissus Schimperi, Afzelia africana, Entada sudanica, Parkia filicoidea,* the fan-palm (*Borassus flabellifer*), etc.

In general it may be stated that the desert type is steadily encroaching on the savannah, which in turn is gradually penetrating the northern limits of the forest region, a [illegible] resulting from a combination of desiccating winds during the prolonged dry period and of human agency (shifting cultivation and burning of the grass). In the drier parts of the savannah, for example in the eastern Sudan, large areas are covered by species of thorny acacia, including *A. arabica,* producing gum-arabic. In somewhat less arid but similar country farther south, in Rhodesia, south-east Belgian Congo and parts of Angola, another leguminous genus, *Bracnystegia,* is very plentiful, and forms almost pure low forest, whilst in the drier semi-desert areas of south Angola and Damaraland a unique example of the vegetable kingdom, *Welwitschia mirabilis,* is found. In the savannah and neighbouring forest regions there are numerous plants with edible fruits and not a few poisonous plants such as species of Dichapetalum (*Chailletiaceae*), the arrow-poison (*Akokanthera*), *Lasiosiphon Kraussianus, Strophanthus,* etc.

The high mountains capping the savannah region, such as the Cameroon mountains, Mt. Elgon, Mt. Kenya, Mt. Ruwenzori, Mt. Kilimanjaro, etc., carry a flora of great interest. On one or other of these mountains it is possible to traverse almost as varied a succession of types of vegetation as might be encountered in a journey from the equator to the vicinity of either of the poles. Many of the genera found on their slopes are represented elsewhere only in the temperate regions of the northern or southern hemispheres. Some of the better known examples are berberis, cornus and anemone, whilst outliers from the Cape region occur, such as *Protea.* The weird forests of tree-groundsels (*Senecio*) and the giant species of lobelia are characteristic features of the East African mountains.

The evergreen forest occupies mainly the low-lying country with a high rainfall distributed throughout the year, and extends in an ever-widening belt from the colony of Sierra Leone to the Cameroons, whence it spreads out over a great part of the Belgian Congo and the Gabun as far as the Victoria Nyanza. This forest sometimes penetrates for a considerable distance into the savannah regions along the banks of rivers. It is particularly rich in endemic species of trees, shrubs and woody climbers, some of which are of great commercial value. The most important timber trees are the African mahoganies (*Khaya, Pseudocedrela, Entandrophragma,* etc.) and numerous trees of the families Caesalpiniaceae, Combretaceae, Simarubaceae and Euphorbiaceae. Amongst ornamental shrubs the numerous species of Mussaenda (Rubiaceae), with enlarged, brightly coloured calyx-lobes, and the brilliant-flowered combretums, are conspicuous The silk-cotton or kapok tree (*Ceiba pentandra*), with its enormous buttressed trunk, often attains gigantic proportions, whilst in West Africa especially the valuable oil-palm (*Elaeis guineensis*) is abundant. As many of the peculiar genera found in this primaeval forest, especially in the Cameroons and Gabun regions, are also found in the Guianas and Brazil on the opposite side of the Atlantic, it seems probable that it is but the remains of a once much more extensive and continuous tract of forest. Apart from Madagascar, the connection between the East African forests and those of tropical Asia is not nearly so marked.

**South African Flora.**—The South African flora, broadly speaking, consists of two main types: the typical Cape or south-western region occupies a narrow strip within the southern coast line In some respects it resembles certain features of the Australian flora, the peculiar families Proteaceae and Restionaceae and certain groups of Leguminosae being common to the two areas and rare in other parts of the world. The vegetation of this coastal area is of a marked xerophilous character and bears a superficial resemblance to that of certain parts of the Mediterranean. It is of the so-called bushwood type, and here and there are tracts of grassland. Intermingled with the shrubs are numerous annuals, herbaceous perennials, succulents, etc Farther inland, between the ranges of mountains, much of the surface is occupied by the "rhenosterbosch," *Elytropappus rhinocerotis* (Compositae). True forests occur only towards the eastern part of the region, in the districts of Knysna and Humansdorp, and the trees composing them nearly all belong to tropical genera. In the north-west a few trees of a conifer, *Callitris juniperoides,* are found, being the sole remains of a once extensive forest. The silver-tree, *Leucadendron argenteum,* is now confined to the Cape peninsula, which harbours as many as a hundred species of Erica. Other striking plants in the same district are the brilliant scarlet *Disa uniflora* and the blue *D. graminifolia,* two beautiful ground orchids. There are also numerous species of the geranium family and many beautiful oxalis, large numbers of which are in cultivation.



A FAMILY OF MAKALANGA NATIVES
The Makalangas are a branch of the Bantu race of southern Africa—an agricultural people and more civilized than the tribes of the interior

Of the remainder of the South African regions perhaps the most interesting and remarkable is the Karroo, which occupies a broad belt in the hinterland of the south-western coast region. It is mainly a vast shallow basin which in former times was the bed of a large lake. Its altitude, according to Bolus, ranges from 1,800–2,500ft., the mountains on the northern margin reaching 8,000ft. altitude. The vegetation is of an intensely xerophytic type, being composed mainly of succulents of weird and diverse form, thornbushes and numerous plants with bulbous and tuberous root-stocks. Trees are almost entirely absent. The predominant families in this region are Compositae, Leguminosae and Ficoidaceae, the last-mentioned being almost entirely represented by about 70 species of the genus *Mesembryanthemum* and its segregates. In this area the exotic *Opuntia* from Central America has become a pest.

The upper and Kalahari regions distinguished by Bolus may for convenience be treated as one. Whilst the families mentioned above are still highly represented, the grass family, Gramineae, takes a very high place, much of the country being grassland (high veld). Here also there is a considerable influx of families and

genera characteristic of the tropical regions to the north. Amongst the Compositae the everlastings (Helichrysum) are conspicuous.

The south-eastern coast region is bounded on the south-west by the Van Stadens mountains and extends northwards east of the Drakenberg as far as the tropic into which it gradually merges. It is essentially a southerly extension of the tropical flora of East Africa, and contains a large number of such tropical families as Asclepiadaceae, Acanthaceae, Rubiaceae, etc. True rain-forest occurs in Natal. The plants so characteristic of the south-western coast region diminish rapidly northward Some of the most striking plants in the area are a large tree-euphorbia (*E. grandidens*) and several species of Eucephalartos (Cycadaceae) and numerous species of aloe. Although nearly opposite the island of Madagascar, there is scarcely anything in common between the two floras.

As in the case of the tropical flora, it seems clear, judging by the history of the vegetation, that the climate of South Africa is gradually becoming drier. (J. Hu.)

## GEOLOGY

Africa has a simpler geological structure than any other continent, although it has many unique features and formations. It consists essentially of a plateau of which the rocks have not been bent into steep folds by compression since primaeval times, except for a strip in Cape Colony, which was part of an ancient southern continent, and for the Atlas Mountains, which are geologically and biologically European. The continent between these remote chains of fold mountains has undergone no close folding, and most of it has remained above sea level since the time of the oldest known fossils. The margins have been repeatedly reached by the sea, which has submerged the coastal plains and occasionally extended inland up the valleys. The plateau has been fractured and cleft by earth movements which occasioned widespread volcanic eruptions; but the plateau surface has remained a land area on which plants and animals have evolved continuously, subject to the stimulus of changing climate, but never interrupted by submergence. Africa is part of an ancient continent which included most of South America, India and Australia. This southern continent, Gondwanaland, was separated from the contemporary northern land of Eurasia, except for an occasional isthmus, by a sea, the Tethys, which extended from central America through the Mediterranean and across southern Asia to the Eastern Archipelago. The range of this southern continent is best established in Carboniferous times; by the Jurassic its disruption had begun by subsidences which formed the Atlantic and Indian oceans, introduced great changes in its biological relations, and repeatedly caused widespread volcanic eruptions.

The foundation of the continent consists of a vast slab of rocks belonging to the Primaeval or Pampalaeozoic era. They are exposed over about one-third of the continent. They outcrop from Cape Town to southern Egypt, and from the Gold Coast on the west to Somaliland, the eastern horn of Africa. Most progress in the classification of these rocks has been made in South Africa, where they have great mineral wealth. They are divided into three main divisions. The lowest, the Swaziland system, consists of gneisses and coarse schists; in addition to the typical areas in South Africa, it forms most of Africa, including Nubia, the highlands along the eastern and Atlantic coasts, and the Sudan from Abyssinia to Nigeria and the Gold Coast. This division corresponds to the old gneiss of other lands, such as the Laurentian of Canada and the Lewisian of Britain.

The second division consists of sedimentary rocks, including quartzites, limestones, dolomites and slaty schists, with vast sheets of volcanic rocks. They are classified in South Africa as the Witwatersrand, Ventersdorp and Transvaal systems. Some of the rocks are so little altered that they have been expected to yield fossils; but none has been found and the *Orthoceras*, said to prove the Ordovician age of the Otavi dolomite, was based on cylindrical concretions. Some of these beds were regarded as Lower Palaeozoic; but they are probably earlier owing to the absence of fossils, and their resemblance to the pre-Cambrian rocks of other continents. The representatives of this division include important copper, lead and zinc mining fields in northern Rhodesia and the Congo basin, the goldfield of Kilo in the eastern Belgian Congo, the goldfields of the Gold Coast Colony and the less important gold occurrences that have been discovered in Tanganyika Territory and Kenya Colony.

The third division includes sandstones that are so little altered that they have been persistently regarded as the inland continuation of the Devonian red sandstones of the coast at Cape Town. The chief member is the Waterberg sandstone of the northern Transvaal, which is probably represented in Uganda by part of the Karagwe series (most of which is referable to the second division), and in Angola by the Oendolongo series. These sandstones are probably the equivalent of the Torridonian of Britain and the Keweenawan of the United States and Canada.

The Palaeozoic era began with apparently the whole of Africa as part of a continent, for the only Cambrian beds known in it are in Morocco near Tetuan, though the sea came close to the eastern coast in Sinai. No certain Ordovician rocks are known, though they have been doubtfully recorded from the Atlas mountains. Many beds in Africa have been called Ordovician and Silurian on inadequate evidence, but some Silurian beds with graptolites occur in the central Sahara.

The Devonian is the oldest African system with widespread fossiliferous beds. It includes the Bokkeveld beds in Cape Colony, and has a wide extent in the Sahara, Libya and the western Sudan, and it reaches the Atlantic on the Gold Coast; marine representatives occur of the lower, middle and upper divisions. Marine Carboniferous rocks occur to the north of the Devonian beds in Cape Colony and limestones with crinoids and *Productus* show that a contemporary sea covered part of Egypt. The Lower and Middle Carboniferous are widely developed in the northern and north-western Sahara, and in south-western Tripoli; and there are small outcrops by the Gulf of Suez. The Carboniferous land deposits are extensive. The lowest part of the Karroo system of southern Africa is Upper Carboniferous and includes the glacial Dwyka Conglomerate and rich coal seams. Coal is also found in southern Rhodesia, Tanganyika Territory and Lake Nyasa. The glacial deposits of this period extend northward into the Congo basin and southern Madagascar. The later divisions of the Karroo system range from the Permian to the Lower Lias and are represented in equatorial Africa; they have yielded many remarkable fossil reptiles. The Permian beds (Lower Beaufort) are represented by shales of freshwater origin with *Palaeanodonta* on the Sabaki in Kenya Colony, and the Trias (Upper Beaufort) by the Tanga beds and part of the Buruma sandstone, of which the fossil *Dadoxylon* forest may be the equivalent of that of the Molteno beds of South Africa. In the Congo there are large areas of sandstones, the Lualaba and Lubilache series, which, judging from their sparse fossils, are Permian and Trias.

There is no established marine Trias in Africa, except for a small development in southern Tunis and along the Atlas of beds like those in Andalusia; though the sea lay a little north in the Mediterranean, most of the Triassic beds of Algeria and Tunis are of the continental type, like those of England and Germany. The breaking up of Gondwanaland had nevertheless probably begun in the Trias, and in the next period, the Jurassic, marine beds were deposited along parts of the east African coast. An arm of the sea then ran up the Mozambique channel between Madagascar and the mainland. The eastern part of Madagascar consists of the primaeval gneisses and schists, on which rest some Karroo beds; the western slope consists of marine Jurassic, Cretaceous and Kainozoic beds, with some volcanic rocks. The Jurassic beds of Madagascar and Tanganyika Territory range from the Lias to the end of the system; further north, in Kenya Colony and Somaliland, the horizons established represent from the Bathonian to the Tithonian. In Tanganyika Territory the Upper Jurassic beds (Corallian to Tithonian) in Tenduguru are famous for their fossil reptiles, of which *Gigantosaurus* is the largest known animal.

The advance of the sea during the Jurassic received in East Africa a check in the Cretaceous; for though a Neocomian gulf ran northward from Uitenhage in Cape Colony past Madagascar, the lowest Cretaceous series is barely represented in Kenya and

its occurrence in Abyssinia is probably due to a gulf from the Mediterranean The widespread Cretaceous rock of eastern Africa is the Nubian sandstone (possibly partly Upper Jurassic), a land deposit which extends from Egypt to Abyssinia and Somaliland In Egypt an arm of the Mediterranean sea deposited Cretaceous beds, which represent all the series from the Lower Cenomanian to the Danian.

A Cretaceous strait in the Upper Albian and Senonian extended from the Mediterranean across the Sahara, past Lake Chad and along the Benue valley as far south as Angola. The Cretaceous in Africa is best represented in Tunis, Algeria and Morocco At the beginning of the period the sea covered a narrow strip of land from the coast to just south of Tunis and Oran; but by the Middle and Upper Cretaceous compact limestones were deposited over much of northern Algeria, and the Cenomanian lagoons lay along the front of the Sahara

In the same region the Cretaceous sea was succeeded directly by that of the Lower Eocene, wherein were deposited the phosphatic limestones that are the most valuable mineral deposit of northern Africa. A still wider submergence in the Middle Eocene formed the Nummulitic limestone, which ranges across northern Africa from Cairo through Cyrenaica and along the Atlas Mountains to Morocco; and a gulf southward extended on to some of the lower parts of the Sahara. A strait from this gulf continued to the Niger valley and covered the district of Sokoto, and reached the Gulf of Guinea in southern Nigeria and the Cameroons. The Oligocene saw a general retreat of the sea from northern Africa, but beds with small Nummulites were deposited in bays. The freshwater lakes of the Oligocene have yielded at Fayum the fossils which revealed to C. W. Andrews the story of the origin of the elephants from the primitive *Moeritherium*.

The Miocene sea along the Atlas was restricted to a strait from Oran to central Tunis, which was one of the passages that connected the Atlantic and the western Mediterranean. A renewed uplift at the end of the Miocene of the channel reduced these straits, though that south of the Riff in Morocco was apparently still occupied by the sea. In other parts of Africa the marine Cainozoic deposits are scanty. The sea occasionally reached the tropical coasts. A full series of Eocene limestones occur in Somaliland, with also the Upper Oligocene. Eocene and Miocene deposits occur both on the coasts of Kenya Colony and in Tanganyika Territory at Lindi; Miocene limestone occurs in the island of Pemba. The marine Pliocene of the Mediterranean is represented in Algeria and Egypt, while marine Pliocene deposits allied to those of the Persian Gulf also occur, notably in Zanzibar island and at Mombasa.

Africa, therefore, has a long stable development, which was occasionally interrupted by volcanic outbreaks connected with the fractures made by the foundering of the adjacent ocean basins. The eastern half of Africa appears to have been slowly upraised during the Mesozoic into a broad, flat arch contemporary with the formation of a great sea-filled trough along the East African coast. The wider subsidence that formed the Indian Ocean led to the giving way of the eastern side of the arch, and the infall of its roof formed the Great Rift valley, which extends from Mozambique throughout eastern Africa and along the Red Sea to the Jordan valley. The fractures connected with its formation were accompanied by great volcanic eruptions, and the Kapitan phonolites of Kenya Colony are probably contemporary with the Deccan traps of north-western India. The earth movements connected with the formation of the Great Rift valley lasted from the Oligocene to the Pleistocene, and they were accompanied by repeated volcanic eruptions. They built up the two highest of African mountains—Kilima Njaro, which still has a crater upon its summit, and Kenya, which is the denuded neck of an old volcano. Subsidences around volcanic centres formed great cauldrons, such as Ngorongoro in Tanganyika and Menengai in Kenya Colony. Volcanoes along the fractures connected with the formation of the Atlantic produced the shonkinite vent at Chiluca in Angola, the volcano of the Cameroons, which is still active, while eruptions along a fracture parallel to the coast formed the islands of the Guinea Gulf, Fernando Po, San Thomé, Principé and Annobon The deepest subsidences along the Rift valley in Africa formed the lake basins of Tanganyika, Nyassa, the Albert Nyanza and Lake Rudolf.

The economic geology of Africa is connected mainly with its rich mineral fields, especially of gold and diamonds in South Africa, southern Rhodesia and the Gold Coast; of gold at Kilo, of diamonds, copper, zinc and lead in Northen Rhodesia and Katanga Tin and platinum are found in the Transvaal, and chromium in southern Rhodesia The most important phosphate deposits are along the Atlas Mountains The only [illegible] African oil-field is on the coast of the Gulf of Suez, oil-shale is known in South Africa, Nigeria and elsewhere; rich coal-fields are worked in the Transvaal, Natal and Southern Rhodesia; and coal also occurs in Tanganyika Territory, Nyassaland and Nigeria. Iron ores are widespread, as are also deposits of bauxite and manganese, which are most extensively worked on the Gold Coast. The chief African mica mines are in Tanganyika Territory.

## TABLE OF FORMATIONS

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| | | CAINOZOIC |
| | *Pleistocene.* | Raised coral reefs. Alluvial river and lake plains. Moraines on Kilima Njaro, Kenya, and Ruwenzori. Elephant beds in Zululand Lavas and tuffs of recent volcanoes. Gravels, desert sands, etc., with Neolithic and Palaeolithic implements. |
| | *Pliocene.* | Marine beds in Tunis and Algeria. Sands with *Clypeaster* in Egypt. Limestones of Zanzibar, Pemba and Mombasa. Naivashan lavas in Kenya. Bone beds at Homa, Omo Valley, etc. Lavas in Atlantic islands, Aden, etc. |
| | *Miocene.* | Marine limestones in Algeria and Tunis. Limestones of Pemba and Tanganyika coast. *Dinotherium* beds of Victoria Nyanza. Limestones of Egypt with oil-field of Gulf of Suez. |
| | *Oligocene.* | In former bays along Mediterranean coastlands. Dubar limestone of Somaliland. Limestones N. of Mombasa and at Lindi. Lake beds of Fayum. Early faulting of Great Rift valley. |
| | *Eocene.* | Nummulitic limestone of N. Africa coastlands; in Sokoto, northern Nigeria; Somaliland; Coasts of Kenya Colony. Tanganyika Territory. Sheringoma in S. Mozambique. *Aturia* beds of S.W. Africa. Widespread volcanic eruptions in Kenya. |
| | | MESOZOIC |
| | *Cretaceous.* | Neocomian to Up. Cretaceous along eastern coast of S. Africa. Neocomian-Cenomanian in Mozambique; Urgovian-Senonian in Tanganyika Territory. Cenomanian-Danian Egypt. Lower to Up. Cretaceous along the Atlas mts. Albian in Angola. Turonian, Benue valley. Kapitian Phonolites of Kenya Colony. Nubian sandstone in Nubia, Abyssinia, and Somaliland. |
| | *Jurassic.* | Upper.—Meragalleh limestone in Somaliland and Kimmeridgian-Purbeckian, with giant reptiles and marine beds, in Tanganyika Territory. Ammonite beds near Mombasa. |
| | | Middle.—Kenya and Tanganyika Territory. |
| | | Lower.—Bathonian and Bajocian limestones in Tanganyika Territory, Kenya (Kambe limestone), Somaliland, and Madagascar. |
| | | Lias. Tanganyika Territory and Jubaland. |
| *Karroo System.* | | Rhaetic. Drakenberg lavas. Upper Tanga beds with plants. Coal series in Natal. |
| | *Trias.* | Marine. Terrestrial Trias in S.S. Tunisia and Atlas Cave sandstone and Molteno beds. Mazeras sandstone with *Dadoxylon* forest in Kenya coastlands. |
| | | Upper Beaufort. Kenya coastlands. Burghersdorp beds of S. Africa. Lubilache sandstones of Congo basin. |
| | | PALAEOZOIC |
| | *Permian.* | Lower Beaufort in S. Africa. Tanga beds. Sabaki shales with *Palaeanodonta*. Tanga beds. Upper Lualaba sandstones of Congo. |
| | *Carboniferous.* | Upper Uralian. Ecca beds with coal-fields of Transvaal and glacial Dwyka conglomerate in S. Africa. Wankie coal in S. Rhodesia. Coals in Tanganyika Territory and Congo. Glacial beds in Congo and Madagascar. |
| | | Middle.—Absent. |
| | | Lower.—Witteberg series of Cape Colony. Crinoid and *Productus* limestone in Egypt. |
| | *Devonian.* | Bokkeveld series of Cape Colony. Marine beds of Sahara, Libya, and Sudan. |
| | | Table Mountain sandstone. |

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| *Silurian.* | Central Sahara. |
| *Ordovician.* | Absent. |
| *Cambrian.* | N.W. Morocco and Gulf of Akaba. |

PAMPALAEOZOIC (PRIMAEVAL)

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| *Upper Division.* | Waterberg sandstone of S. Africa. Oendolongo beds, Angola. |
| *Middle Division.* | Transvaal, Ventersdorp, and Witwatersrand systems in Transvaal and S.W. Africa with representatives in Rhodesia, southern Congo. Lepi series of Angola. Kandelurgu and Karagwe quartzites of Tanganyika and Uganda. Banket series of Gold Coast. |
| *Lower Division.* | Swaziland system with gneiss Schists of the main foundation of the African continental plateau. |

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## ANTHROPOLOGY AND ETHNOLOGY

**North Africa and Egypt.**—Apart from Egypt and the Nile Valley the divisions of Africa north of the Sudan are in the main political and from the anthropological standpoint almost entirely artificial. Not only are the Egypto-Tripolitan and the Morocco-Algerian frontiers entirely conventional, but even the Libyo-Tunisian frontier lacks the ethnic significance it might possess if instead of leaving the Mediterranean in the neighbourhood of Cape Roux it ran almost due south from the Gulf of Gabes. The political divisions of the western portion of North Africa—Africa Minor—thus stand in sharp contrast to its natural unity, so well-defined between the desert and the Mediterranean that the early Arab geographers named it Geziret el Magreb, "the Western Island." It is also necessary to realize that the predominantly Arab complexion of North Africa and the general substitution of Hamitic languages by Arabic began little more than 1000 years ago, while to appreciate the vast area of country over which the spread of Arab influence has obliterated or modified the earlier Berber tongues reference should be made to some such linguistic map as that given by Meinhof in *Die moderne Sprachforschung in Afrika* (Berlin 1910).

**The Berbers and Their Position in North Africa.**—While Sergi (*Antropologia della Stirpe Camitica*, Turin, 1897) regards the Berbers as the northern branch of the Hamitic stock (the Eastern Hamites being typically represented by proto-Egyptians, Beja and Galla), Keane (*Man, Past and Present*, Cambridge, 1920) quotes T. A. Joyce to the effect that it is impossible to prove the connection between Eastern and Northern Hamites, and that the latter should be regarded as the African representatives of the Mediterranean race. The question is largely a matter of terminology, since we cannot doubt the close relationship of the groups commonly termed Mediterranean, proto-Egyptian, and Beja.

The term Moor, which is often applied to the townsmen of Morocco, is here purposely avoided, and with Collignon and Deniker ("Les Maures du Senegal," *L'Anthropologie*, 1896) is restricted ethnically to a group of peoples lying between the Senegal River and Morocco and extending east to the Tuareg country.

**Egypt.**—For Egypt alone in North Africa it is possible to construct a connected anthropological record, which, in spite of gaps, reaches back to the very dawn of history. Some forty years ago Flinders Petrie and J. E. Quibell discovered at Naqada and Ballas in Upper Egypt a series of cemeteries belonging to a people with a mode of life and habit of burial utterly different from those of the dynastic civilization previously known in Egypt. Their discovery was followed up and extended by de Morgan, who recognized that Petrie's "new race" preceded even Mena, traditionally the first ruler of a united Egypt, whose tomb he found and excavated. Unfortunately de Morgan applied the term "neolithic" to this newly discovered people, a complete misnomer —though still used in French works—since detailed archaeological examination indicates that copper occurs in the earliest graves in

these cemeteries. These early inhabitants of the Nile Valley are now known as the predynastic or proto-Egyptians, terms which respectively emphasize their position in time and their ethnic relation to the other inhabitants of the Nile Valley.

**The Pre-dynastic Egyptians.**—The proto-Egyptians have been best described by Elliot Smith, who writes of them (*The People of Egypt*, Address to Cairo Scientific Society, 1909) as a people slightly below the average size of mankind, with muscular development so feeble that it may be difficult to determine to which sex an isolated skull belongs. In physical character they exhibit a remarkable degree of homogeneity. Their hair was dark, and either straight or wavy, never woolly. In the men apart from a chin-tuft beard there was the scantiest development of facial hair. These proto-Egyptians had long narrow heads with a narrow forehead and prominent occiput, so that the skull when viewed from above presents a characteristic form which has been termed "coffin-shaped." The face was a moderately long and narrow ellipse, and the chin was almost always pointed. More precisely, they were longheaded, with a cranial index of 73 (Naqada) and a mean height estimated at a little under 65 inches for men and about 60 inches for women, and though there can be no direct evidence as to skin and eye colour there is no doubt that they had dark eyes and skins of a yellowish brown or pale copper colour.

**The Dynastic Egyptians.**—All this applies only to the population of Upper Egypt; knowledge is lacking of the inhabitants of the delta at this early period, as of the whole of Lower Egypt until the time of the pyramid builders. Among the skeletons of this date from the neighbourhood of the pyramids Elliot Smith found a considerable number in which the skeleton was more robust, with a bigger and especially a broader skull without the angularity and the projecting occiput of the proto-Egyptian type; there are modifications in forehead, orbits and nose, with particularly obvious differences in the jaw, in fact the type of man buried round the pyramids belonged to that well characterized group known as the dynastic Egyptian, which in antiquity is represented by the Saqqara "Scribes" and the Sheikh el Belled, and is essentially that of the peasant Egyptians, the *fellahin* of the present day. For a detailed account of skeletal material, and especially of crania, throughout the dynastic period *see* A. Thomson and D. Randall-Maciver *The Ancient Races of the Thebaid* (Oxford 1905). Elliot Smith (*The Ancient Egyptians*, 1923, chapter 7), arrays evidence that long before the New Empire, Egypt was permeated from end to end by this foreign element, which in his opinion carries the physical traits of the Armenoid race. There is however one difficulty in accepting this view, which does not arise from any examination of the skeletal remains but results from the large number of portrait statues which the Egyptians have left to us, namely, that although so many of these statues exhibit the broader face and heavier jaw brought in by the alien race, not one of them exhibits any approach to the typical Armenoid, so-called "Jewish," nose. If therefore the foreign element is to be termed Armenoid it can only be called by this name so long as it is realized that this does not imply the presence of one of the most characteristic features of that race as known at the present day. The difficulty is not lightened by the fact that less than 1000 years later at Beni Hassan there are excellent representations of the Aamu, a people of the eastern desert with typical Armenoid noses.

**Contemporary Representations of Beja.**—The proto-Egyptian type persists to the present day among the southern Beja (*q.v.*), tribes of the Anglo-Egyptian Sudan. It also occurs, though probably in less typical form, among the Ababda of the Eastern (Egyptian) Desert and the riverain settlements in the neighbourhood of the first cataract. We have direct evidence dating from about 2000 B.C. of the existence of the pure proto-Egyptian type among a people wearing their hair in the same fuzzy mop as the Beja of the present day on the eastern border of Egypt. Among the wall paintings of the 12th Dynasty in the tombs at Meir (A. M. Blackman, *The Rock Tombs of Meir*, vol. ii., Pl. xxx., London, 1915), is one that undoubtedly represents a Beja. The long thin figure and limbs, with broad chest, narrow flanks and retracted abdomen, are no doubt conventional and exaggerated representations of the characters of the lean pastoral desert men as they appeared to the agricultural Egyptians, but there can be no criticism of the splendid naturalism of the lined face, the thin pointed nose and the mop of hair projecting over the forehead and standing out stiffly over the whole head to the nape of the neck. The beard is the usual chin tuft of the Beja tribes, and comparison with modern Beni Amer clinches the identity of the two peoples, living in the same desert area but separated by 4,000 years. Confirmatory evidence of the proto-Egyptian characters of the inhabitants of the eastern desert and of their civilization is offered by the discovery by G. W. Murray of a burial of late pre-dynastic date, with characteristic grave goods, near Ras Samadi on the Red Sea Coast, in lat. 24° 59′ N. (*Man* 1923, *81*). The skull accorded well with those of the pre-dynastic Egyptians.

The desert must indeed be regarded as a reservoir not only of early archaic physical types no longer preserved in the richer Nile lands but also of ancient ideas and appliances, *e.g.*, the camel stick of the Ma'aza of the Eastern Desert is no other than the *Uas* sceptre of ancient Egypt applied to a new use.

**The Arab Element.**—The Arab conquest, which politically altered the whole history of Egypt, had no appreciable influence on the physique of its inhabitants. While in part this may be due to a certain physical resemblance between Arabian and Egyptian the numerical inferiority of the conquerors must be held to be the determining cause. The nature of the invasion may be best illustrated by considering the history of the Juhaina (Sudanese, Guhayna). The tribesmen took a prominent part in breaking the power of the Christian kingdom of Nubia; yet in spite of their importance in the past, at the present day few groups that may fairly be called Arabs exist except in association with the desert. Such are the fisher folk of Lake Menzaleh, who trace their origin to Sinai; the Harabi of the Fayum, extending into the Tripolitan desert, still pastoral nomads; the Aulad Ali of the Behera district of the Delta, no longer nomads; and the practically sedentary Howeitat of Matarieh; all dolichocephals or low brachycephals. In the Eastern Desert the only important Arab tribe is the Ma'aza, about whom very little is known, described by Chantre (*Recherches Anthropologiques en Egypte*, Lyon, 1904), as short dolichocephals.

Besides these more or less well-defined groups there is in Upper Egypt a small number of people, generally mobile in their habits, living along the edge of the cultivation. These folk generally keep goats and often own a few palm trees, and formerly may have been of more importance as charcoal burners. Somewhat in the position of gypsies in England fifty years ago, they are generally unpopular with the *fellahin*, on whom they levy a certain amount of blackmail. Such groups as the Bili, near Baliana, and the Aleiqat, of whom there are a considerable number near Qus, do not come into this category.

In Sinai, with a total population of some 10,000, the chief tribes are the Howeitat, the Tiyaha and Terabin, in the North; in the South the Tawara (*i.e.*, the people of Tor), who include the Aleiqat, the Sawalha and Muzeina.

**The Modern Egyptian.**—Passing to the *fellahin*, the modern Egyptian, the most important of the numerous studies that have been made are those of C. S. Myers ("Contributions to Egyptian Anthropology," in vols. xxxv., xxxvi., and xxxviii. of the *Journal of the Royal Anthropological Institute*) and of J. R. Craig ("Anthropometry of Modern Egyptians," *Biometrika*, vol. viii., 1911). Omitting the province of Aswan and the town dwellers, these papers, which must be regarded as complementary, indicate that the Egyptian peasant has a stature of approximately 65½in., showing no sharp division between Upper and Lower Egypt; he is longheaded, with a cephalic index of about 75, the cephalic index—again omitting Aswan—being about a unit higher in Lower than in Upper Egypt. There is no evidence that the natives of various provinces differ in variability, nor is it possible to resolve distribution curves, whether of measurements or indices, into components corresponding to hypothetical underlying ethnic types, though it seems that passing from Lower to Upper Egypt

eye and skin colour darken and the proportion of unusually broad noses increases as does the frequency of spiral and crisp hair, all evidences of increased though still well diluted negro blood in the population.

The position of the Copts (the Christian population of the present day, and therefore with insignificant exceptions the descendants of the Egyptians who refused to relinquish their faith at the Conquest or during the succeeding centuries) is particularly interesting. The observations available refer to Coptic peasants, not town dwellers, and so far as these go the remark commonly made by Europeans that they can distinguish at sight between Muslim and Copt is not borne out. No significant deviation from the general Muslim population is found as regards head measurements or facial characteristics, though the nose is slightly less broad and the lip slightly thinner, with eye and skin colour a trifle lighter. Thus, diagnosis at sight between Copt and Muslim, if really practicable, cannot rest on easily defined physical characteristics but must be attributed to such other factors as gait, dress, etc.



BY COURTESY OF NORTHERN BAPTIST CONVENTION

A NATIVE OF BELGIAN CONGO

Of powerful physique and expert huntsmen, a few of the tribes in the Belgian Congo persist in cannibalism

The measurements and photographs of natives of Kharga Oasis published by Hrdlicka (*The Natives of Kharga Oasis, Egypt,* Washington, 1912) show that its inhabitants are Egyptians, differing in no essentials from the inhabitants of the Nile Valley. The inhabitants of Siwa speak a Berber dialect, akin to Tuareg, with many Arabic loan words, some so profoundly modified that their origin is not immediately apparent. Jaghbub (Jarabub), in Italian territory, is believed to have been uninhabited before its occupation by the Senussi, whose capital it now is.

**Disposition of the Fellahin.**—Difficult as it is to sum up the temperament or disposition of a people it is probably true to say that the *fellahin* are in the main good natured, cheerful and excitable, genuinely religious but not generally fanatical, though certain centres such as Tanta have a bad reputation in this respect. They are liable to occasional bursts of ferocity (such as distinguished the rioting of 1919), and inter-village enmities, leading to fights with iron-shod staves, were formerly fierce and persistent. Nothing approaching an adequate account of the beliefs and customs of the *fellahin* has yet been written, for Lane's *Modern Egyptians,* first published in 1836 before western influence had contaminated Egyptian habits and modes of thought, though giving an invaluable account of Cairene life and manners cannot be held to apply except in somewhat general terms to the habits and beliefs of the peasants, which even preliminary inquiry will show to vary not only from those of the towns but as between Upper and Lower Egypt. Meanwhile the work of Miss Winifred Blackman (*The Fellahin of Upper Egypt,* 1927) avowedly only a preliminary account, contains much useful information.

**Tattoo, etc.**—Tattooing is the most obvious, common and widespread method of bodily enhancement and mutilation. Lane mentions the simpler designs—dots, lines and circles—common in women and refers to the "extremely displeasing" habit of the women of Upper Egypt of discolouring their lips with tattoo. C. S. Myers ("Contributions to Egyptian Anthropology, Tattuing," *J.R.A.I.*, vol. xxxiii., 1903) found that of about 400 male subjects nearly 100 were tattooed, the designs falling into two main classes, namely simple, generally geometrical, designs, and pictorial representations, *e.g.,* the façade of a mosque or the Persian lion with sword. Local examples of the type prevailing throughout North Africa form the first class while the latter are derived from eastern sources. Circumcision is universal; clitoridectomy, though far less recognized by Europeans, is customary in cities, at least among the poorer class, and may be equally common among the Fellahin Both long antedate Islam, circumcision being represented in a tomb of the pyramid age at Saqqara, while clitoridectomy or a similar operation is alluded to by Strabo —*Circumcidunt etiam mares et foeminas excidunt.*

**Survivals from Ancient Egypt.**—One of the most interesting features of present day Egypt is the persistence in popular belief of ideas traceable to ancient Egypt, especially intricate ceremonies connected with mourning, the survival of the belief in *ka* or double, the persistence of a ceremony in which a sacred boat takes a prominent part, and the superstitions connected with particular days in the calendar. The boat ceremonies are particularly important, since these exist widely in Asia outside the Near East (*e g*, in Ceylon) and it seems probable that their distribution has been to a considerable extent brought about from Egypt by the spread of Islam. Nearly 20 years ago the writer observed a full-sized river boat suspended in a tree outside Luxor; enquiries showed that once a year this was placed in a cart, filled with children and dragged round the fields. Actually there are three boat processions every year in Luxor, the most important being observed in honour of Abu'l Heggag, the patron saint of Luxor The substitution of Amon and his sacred barque by Abu'l Heggag and his Nile boat is suggested by the popular belief at Karnak that on certain nights the golden boat of Amon may still be seen to emerge from the waters of the sacred lake, steered, as of old, by the Pharoah.

The calendar customs are a striking example of how beliefs attached to a particular day may last for over 3,000 years, persisting through a complete change in the mode of reckoning time, as well as the introduction of new beliefs. The Sallier papyrus, which dates from the time of Rameses II. or possibly his successor, gives an account of the lucky and unlucky days in the year, and describes in some detail the quality of the good and bad luck, with instructions for behaviour on each of these days. It may first be noted that the five epagomenal days of the old Egyptian year were unlucky. In modern Egypt the epagomenal days are still observed to the extent that neither sowing nor planting should be undertaken, mares and cattle should not be covered lest their offspring be misshapen, and it is even believed that children begotten during these days will show some abnormality. A still more interesting example perhaps is that afforded by a day near the end of the old Egyptian month of Choiak; the Sallier Papyrus marks the 26th of this month as most unlucky, and of this day it is written, "Do not eat fish. Those residing in the midst of Tattu turn themselves into the fish An." The mythological allusion cannot be explained, but the modern popular calendar, such as is hawked about the Bazaars, notes that on the 11th of Moharram (corresponding to the 26th day of the Coptic month Kyhak) "the eating of pigeons is liked, that of fish disliked."

**The Beja Tribes of Egypt.**—Of the Beja tribes of the eastern desert the Ababda (*q.v.*) fall wholly within Egyptian territory; the Bisharin extend some 80 miles south of the boundary and occupy a strip of territory stretching along the right bank of the Atbara. While the physical characters of both tribes have been studied by E. Chantre (*Recherches Anthropologiques en Egypte,* Lyons, 1904) and the mode of life of the Bisharin described by Linant de Bellefonds (L'Etbaye, 1858), two recent papers by G. W. Murray ("The Ababda," *J.R.A.I.,* vol. liii., 1923, and "The Northern Beja," vol. lvii., 1927) constitute by far the most valuable account of these people. The Ababda inhabit the eastern desert from the Sudan frontier to north of the Kena-Kuseir road, and there are isolated colonies along the edge of the cultivation from Assiut to Korosko. In the time of Bruce their southern range was limited by the 'Atawna (Arabs) who have now vanished from the desert. Earlier yet Makrisi records the Beli (Bili) a tribe of which scattered groups still exist along the edge of the cultivation—as being in possession of parts of the desert now belonging to the Ababda. The desert Ababda intermarry with the Bisharin, and those settled in the Nile Valley with the Fellahin, but they do not appear to intermarry with any Arab tribes still carrying the desert tradition. Like other Beja tribes the Ababda wear the *dirwa,* the shock head-dress of hair

besmeared with mutton fat, though this custom is gradually dying out. Unlike their Beja neighbours to the south the Ababda speak Arabic, but coloured by Bedauye (*To-Bedawi*) words, while transposition of consonants—a Hamitic rather than a Semitic feature—often occurs

In physique the Ababda resemble the Beni Amer, and therefore the predynastic Egyptians, *i.e.*, they are longheaded with a cephalic index of 73·6 and a stature of 1·63 metres. The Bisharin on the other hand present two types, those of the Red Sea coast with a cephalic index of 74·7, and those living inland with a cephalic index of 78 4, the latter substantially identical with the index given by Chantre, presumably derived from individuals living in or near the Nile Valley. (Murray, *op cit.*)

**Tripoli.**—Westwards beyond the Egyptian frontier knowledge of the physical anthropology of Tripoli is but slight. At the extreme west of Italian territory, *i.e.*, in the area surrounding Tripoli city, the systematic observations of Bertholon and Chantre show that the population is predominantly long-headed and of rather low stature (below 1·65m ) but there is an island of high brachycephaly in the immediate area of Bu Ajilat, though these brachycephals exhibit no marked departure from the general low stature of the area. Throughout the rest of Tripoli but few observations have been made, certainly not enough to permit of any connected anthropological history or description of the country. The observations of the late Oric Bates at Mersa Matruh, not far east of the Egyptian frontier ("Archaic Burials at Marsa Matrûh" *Ancient Egypt,* 1915, Part IV., p. 158) suggest that at a period possibly as remote as that of the pyramid builders the population of the coastal plain was not unlike that of the proto-Egyptians, and presumably a people of some such type long continued to form the basis of the population of the coastal plain. Evidence such as that afforded by the ram of Bu Hamama (in Algiers) crowned with the sun-disk and uraei, as well as the presence of the sun-disk on Carthaginian coins, indicates the very considerable cultural influence exercised by Egypt along the north African littoral in late dynastic times, but so far there is no direct evidence of Egyptian influence on the physical anthropology of the country. Nor is there any knowledge in this sense of the effect of the Roman occupation. Herodotus, however, describes the Libyans east of Lake Tritonis, *i.e.*, the inhabitants of Tripoli, as nomadic and thus differing from the settled agricultural peoples of what is now predominantly Algeria, although it is clear that many of these people were in fact no more than semi-nomadic; the Nasamones for instance with their main settlements on the Syrtic shore, left their herds in summer and went up to Aujila for the date harvest, just as some "nomad" Arab tribes of the present day sow their crop in the oases in the autumn, leading a more or less wandering life until the spring.

Apart from the littoral belt the greater portion of Tripoli is desert or poor steppe, for the most part with an annual rainfall varying from three to less than ten inches, such a country can never have been densely populated or have offered any great temptation to highly civilized folk. The position is different with regard to nomads or semi-nomads; here is a sparsely inhabited area which could scarcely fail to attract the Arab tribes that poured into north Africa after the conquest of Egypt under the Khalif Omar, and again in the eleventh century when, in 1048, the Wazir of the Fatimid Khalif Mustansir launched a number of the nomad tribes of Upper Egypt, including the Beni Halal, against his master's orthodox vassals of the northern African States. Each man was given a camel and a gold piece on condition that he would settle in Maghreb, with the result that within two years Cyrenaica had been pillaged and Kairwan captured. But the western movement of the Hilali invasion did not stop here, for while the majority of the Beni Hilal settled in Tripoli and Tunis, and the Athbej passed into what is now Algeria, as far as the Aures mountains and the river Zab, the Makil pressed westwards as far as the high plateau of Morocco-Algeria. Beneath this flood the Berber tongue largely disappeared, and except among the Beni M'zab, the Abadite schism was almost wiped out.

At the present day the population of the coastal plain may for practical purposes be regarded as Arab, and since with the exception of the towns and the oases of the far south the coastal plain—never more than 20 miles in width and generally less than this—constitutes almost the whole of the available territory suitable for agriculture, the Arab tribes of this area form the predominant factor in the population of the country. Of these tribes the Awlad Ali may be taken as the type. Extending from the outskirts of Alexandria to the neighbourhood of Tobruk they grow a considerable amount of barley, and (at any rate before World War I) possessed horses, sheep and camels, the latter constituting their main wealth. Predominantly sedentary, and horsemen rather than camel-men, they yet live in tents. Their tribal organization is into sections and divisions as among the Arabs of the Sudan, whom (*e.g.*, the Kababish) they closely resemble physically to judge from the measurements given by Chantre But not all the folk who have been described as Tripolitan Arabs are long-headed; an examination by Mochi ("Presentazione di crani d'indigeni di Tripoli" *Archiv. per l'Antrop. e la Etnol.,* Florence XL, 1912, p. 381) of the skulls from Tripoli in the National Museum at Florence indicates that they contain at least one hyperbrachycephalic group. Remarkable as is this fact, its significance becomes clear in the light of a series of skulls described by Giuffrida Ruggeri ("I Crani Egiziani antichi e Arabo-Egiziani dell' Università di Napoli," *Atti della Società Romana di Antropologia,* XV., 1910, pp. 112 *et seq.*) from an ancient Arab cemetery at Abassieh near Cairo, with an average cranial index (13) of 85·3. The significance of these skulls and their relation to definite areas of round-headedness in Tripoli has been studied by Seligman ("The Physical Character of the Arabs," *J.R.A.I.*, vol. xlvii., 1907), who points out that their characters indicate that the Abassieh skulls belonged to natives of Southern Arabia, that brachycephaly prevails both in southern Arabia and in the Levant, and that both these areas have contributed to the population of North Africa.

**Barbary (Tunis, Algeria, Morocco).**—Tunis, Algeria and Morocco, are but artificial political divisions of one natural area, which from the anthropological as well as the geographical aspect might still be called by its old name of Barbary. Its inhabitants, the Berbers, are commonly regarded as aborigines, and apart from immigrant stocks this seems to be true as far back as the end of the palaeolithic period. The physical anthropology of the natives of Eastern Tripoli, Tunisia and Algeria, has been exhaustively studied by Bertholon and Chantre (*Recherches anthropologiques dans la Berberie Orientale Tripolitaine, Tunisie, Algerie.* Lyon, 1912). The following facts give a rough idea of the progressive weakening of Arab influence, passing from East to West, and the physical characteristics of the three main groups generally recognized.

In Tunis, with a total Islamic population of something over two millions, there are about half a million Berberized Arabs and less than 100,000 Berbers, forming for the most part two isolated masses, the Matmata in the far south in the neighbourhood of Jebel Nefusa, and a group mainly of the Ababdite (Kharijite) heresy in the island of Jerba. Passing westwards to Algeria there are pure Berber groups in the Kabyle hills and in the Aures mountains. Apart from these two areas the remainder of the province of Constantine may be regarded as inhabited by Arabized Berbers except for a few Arab coastal areas. Numerically some 75% of the inhabitants of the province may be regarded as Berber or Berber-speaking, the remainder Arabs or partially Berberized Arabs. In the department of Algiers Arabs mixed with Arabized Berbers preponderate, while in Oran the Arab element is frankly dominant. In Morocco on the contrary the Berbers are not only in great numerical majority but socially form by far the most important groups. Here it is calculated that not more than five per cent of the population are Arabs, with perhaps another five of Berberized Arabs, the remainder of the population being fairly equally divided into pure Berbers and Berbers with a tinge of Arab influence. Nothing would be gained by attempting to enumerate the "Berber" and "Arab" tribes of Morocco. Westermarck (*The Moorish Conception of Holiness,* Helsingfors, 1916) divides the Berbers into five groups:—(1) the Ruâfa—the Berbers of the Rif—whose country extends along the

Mediterranean coast from the neighbourhood of Tetuan to the Algerian frontier; (2) the Berāber, who inhabit the mountain regions of Central Morocco and the eastern portion of the Great Atlas; (3) the Shleuh, inhabiting the western part of this range, and to the south of it in the province of Sūs a territory with an eastern frontier running from Demnat in a south-easterly direction and a northern frontier uniting Demnat with Mogador on the Atlantic coast, following more or less closely the foot of the mountains; (4) the Dra'a, who inhabit the valley of the Wad Dra'a in the extreme south of Morocco; (5) various tribes living in the neighbourhood of Ujda, in the north-east of the country. The so-called "Arabs" are the Jebala, the mountain-dwelling tribes of Northern Morocco, with their centre in the area between the Rif and Fez and extending westwards of the latter.

**Physical Characteristics of the Berbers.**—Morocco, is from the standpoint of physical anthropology for the most part unexplored. Three physical types of Berber are, however, generally recognized: (1) tall men, with a stature of about 1·70m , dolichocephalic, with strongly marked supraorbital ridges, the face long, tending to oval, the cheek bones by no means prominent, nose long and narrow, chin square and rather scant beard. This type appears to form perhaps half the population of Tunisia and is widespread in Algeria. (2) The second type is short, with a stature of about 1·63m., longheaded, with a prominent occiput so that the head when viewed from above is distinctly pentagonal; the face is short and broad, the cheek bones well developed, the nose tends to be broad, the chin prominent and often well bearded, the lips full. This type is to be found in the mountains of central Tunisia, in the neighbourhood of Gabes and of Algiers, in the south of Algeria, as well as all over Morocco. It seems to be generally accepted that the skulls found in the megalithic monuments of this part of Africa belong to one or other of these types. (3) The third group is of moderate stature, 1·64m. to 1·65m., and brachycephalic. The face is broad and short, the forehead round (*bombé*), nose short and broad. This type is specially present in the Island of Jerba and in the oasis of M'zab; it is also found in the hills to the south of the Gulf of Gabes, western Tripoli, and on the Algerian littoral, as well as among the Kabyles and the inhabitants of the Aures hill. Many of the M'zab have a skin so pale that they burn wheaten colour rather than brown in the sun.

While the number of the blonde Berbers certainly varies locally and their proportion has no doubt often been exaggerated (at least in Algeria), a competent anthropologist, the late Anthony Wilkin, specially studying the problem, has recorded that of the observed population of El Arbaa fully 20% were "fair men" (*Among the Berbers of Algeria,* 1900, p. 77). Good observers always lay stress on the essentially white quality of the skin of the pure Berber tribes. The origin of this blonde element has been much discussed; it is no doubt foreign—presumably Nordic, with perhaps Alpine admixture—and it existed in Libya as long ago as the New Empire, as is shown by contemporary paintings in Egyptian tombs.

**Cultural Characteristics of the Berbers.**—On the psychical side some of the main Berber characteristics can perhaps be best appreciated by contrasting them with those of the Arab; moreover such a comparison is particularly useful since apart from the Nile Valley it in some sense embodies an epitome of the history for some 1,200 years of the whole of North Africa.

The Berber is essentially an agriculturist, with a passionate love of the soil upon which he has been born, though a keen trader, often willing to take service abroad but always anxious to return to his village in his old age or when he has amassed a competence. He is a stern fighter, often a determined brigand and in religious matters a born sceptic, while his strong democratic tendencies are indicated by his social organization in which leadership is usually a matter of election, though raiding and war may give real authority to individual strong men which may to a limited extent pass to their descendants. In contrast, the Arab is typically a nomad pastoralist, whose attitude to agriculture is mirrored in the proverb that shame enters with the plough, a poor worker, whose real courage is less likely to be shown when raiding than on a point of honour or as an expression of his religious faith. Moreover, Arab society is essentially aristocratic; the Arab is, and always has been, ruled by hereditary leaders, and his struggles when he does revolt are spasmodic, and directed against the individual rather than the system With this aristocratic and religious bias there exists a strong contempt not only for the stranger but for Muslims of other sects, and here again he stands in strong contrast to the Berber These contrasts are of course not absolute; there are nomad Berbers, and many sedentary Arabs; some Berbers become really good Mohammedans, though generally there is much truth in the epigram that the Berber is not a Mohammedan but only thinks he is. Moreover, in the West, *i.e.,* in Algiers and Morocco, there is always the difficulty of knowing whether a given people not obviously Berber or Arab should be regarded as Arabized Berbers or Berberized Arabs. Here social organization and history rather than language seem to be the best guides.

**Political and Social Organization of the Berbers.**—In spite of the religious and cultural influence of Islam the social organization of the Berbers differs in every essential from that of the Arabs. The following outline (*see* MacIver and Wilkins, *Libyan Notes,* London, 1901), in principle valid throughout Barbary, applies specifically to the Kabyle Hills. The Berbers are typically hillmen, living in isolated villages, formerly often well fortified or with a central citadel, and, while possessing flocks and herds which in particular instances may regulate their mode of life, are essentially skilled agriculturists, who have long practised irrigation and are quick to take advantage of every scrap of cultivable ground in the difficult and often sterile hills among which they live.

The unit of government is the village, each possessing complete autonomy. A number of villages form the tribe, the connection being administrative and not regulated by kinship. A union of several such tribes may be termed a Confederation; the bond is looser than in the lower federative grade and the confederation never interferes in the affairs of its tribes unless directly appealed to or when vitally necessary. In time of war a head is appointed for each of the tribes and for the confederation. The tribe has deliberative and administrative duties, such as the determination of questions of peace and war, the making of roads, and manages tribal property such as mosques, tombs of saints, and educational establishments; it is concerned with the levying of taxes necessary for these purposes, and may act as arbiter between villages. A general assembly of the tribe is almost unknown, its affairs being managed by a deputation of the chief men from each of the villages composing it.

Every village is brought into contact with its neighbours by means of its *sof,* of which there are always two, the term signifying a group whose members covenant to render mutual aid to one another in cases of necessity. In each village the two *sof* are in some sense opposed, and each *sof* will be allied with similar fraternities in neighbouring villages, the ramifications of the *sof* organization extending through entire districts. Within the village the members of each *sof* are united by the closest bonds, the obligations ranking above all personal interests and even ties of kinship. Nevertheless, though loyal to his *sof* while he is a member of it, the Kabyle thinks little of transferring his allegiance from one *sof* to another if he thinks he will gain thereby, and outside the village the members of a *sof* though willing to assist their fellows with provisions and even with money would expect to be paid for any active armed assistance they might give. The funds of the *sof* are raised by subscription from members and are administered by the heads of the organization, usually men of powerful families and of private wealth, who may disburse considerable sums on secret services without rendering account to the members.

Within the village affairs are controlled by the *jemâa,* the general assembly of the citizens, of which every adult man is a member though in practice only the old men and heads of families exercise the right to speak. Nothing which concerns the welfare of the village escapes the control of the *jemâa*—it exercises judicial authority, makes laws, levies taxes and administers the public property. Decisions are not taken by a majority of votes

introduction of Islam In the south, although the negro has given his name to the Sudan (*Bilad el-Sudan*, the Land of the Blacks of mediaeval Arab authors) and has excited the greatest interest from mediaeval times onwards, yet adequate knowledge is lacking of the habits, customs and religion of any one tribe.

The tribes of the Northern area belong to two great families, (*a*) Hamite, and (*b*) Arab. The Hamites proper include the group of tribes known historically as the Beja (*q.v.*) inhabiting the Red Sea Province and outside the Anglo-Egyptian Sudan extending into Eritrea. Less purely Hamitic, but none the less to be classed as Hamites, are the inhabitants of Nubia, commonly called Berberines or Barabra (*q.v.*), for, in spite of much negro blood and a language which is commonly regarded as negro, history indicates that fundamentally they are of Hamitic origin, while their civilization is not and seems never to have been negro in character. (*See* ARABS; BARABRA; BEJA.)

The true negro undoubtedly represents one of the most primitive of the African stocks. His main physical characteristics are tall stature, a "black" skin, woolly hair and moderate dolichocephaly, a flat broad nose and thick and often everted lips, prominent cheekbones and a varying degree of prognathism. With these qualities there go certain cultural characteristics. Such true negroes are found in the far western Sudan and the Guinea Coast, but hardly in the valleys of the Nile or of its affluents where as far as many of its most characteristic groups are concerned there is evidence of old Hamitic mixture. It is indeed scarcely possible to go further than this at the present time. In a classification proposed by Westermann, based on linguistic criteria, the term Nilotic is used in a sense so wide that it seems to signify no more than related to the Nile valley, but within it three groups are constituted, "High," "Middle" and "Low" Nilotic, which in part at least may be natural.

1. The High Nilotic group, comprising Mittu, Madi, Abukaya, Abaka, Luba, Wira, Lendu and Moru.

2. The Middle Nilotic group, comprising Shilluk, Anuak, Beir, Jur, Belanda and many of the peoples of Eastern Uganda, the Acholi, Lango (*q.v.*), Aturu and Jaluo.

3. The Low Nilotic group, comprising Dinka and Nuer.

This classification, though of wider geographical scope, embraces the whole of the Anglo-Egyptian Sudan, but the Bari with their numerous constituent "sub-tribes" are not mentioned, nor are the Lotuko-speaking tribes. Westermann places the former in his Nilotic-Hamitic group, *i.e.* with the Masai, Turkana, etc. to which the Lotuko-speaking tribes may also be assigned. For descriptive purposes, the following scheme is proposed:

A. Tall "black" dolichocephals, comprising Dinka, Shilluk, Nuer, Anuak, with perhaps some others as yet unclassified. These are the typical Nilotes of most writers, and in this article the term will be confined to this group. The mesaticephalic Acholi no doubt arose within this group, which probably also gave origin to the Belanda and the (Shilluk-speaking) Jur.

B. Tall "black" mesaticephals (probably sometimes brachycephals) comprising some Nuba and probably a number of the little-known tribes of Dar-Fung, including the Barun.

C. Medium statured "black" dolichocephals, comprising the Bari (but probably not the majority of the Bari-speaking tribes of the west bank), the Lotuko-speaking tribes and perhaps some of Westermann's High Nilotic group.

D. Short mesaticephals, with skin showing a coppery tinge—the Azande—or with blacker skins as the Bongo, Mittu and probably a number of the tribes now constituting the Azande nation. Knowledge of this group is very limited.

This classification by no means includes all the tribes of the Sudan. Many of the peoples of the Bahr-el-Ghazal Province are quite unknown ethnologically, *e.g.* the Moro, the Kaliko, the Bukuru (Babuckur) and the Liggi, and even the relations of such important Bari-speaking tribes of the west bank as the Mandari, Kuku, Kakuak, Nyangbwara and Fajelu, are far from clear. Nor is there any substantial knowledge of the Madi, who in the south cross the political boundary into Uganda. In the east, on the borders of Uganda and Abyssinia, are groups of unknown tribes, some of which may constitute ethnic units, *e.g.* Didinga, Longarim, Murle, with perhaps further north and nearer the Nile the Beir (Ajiba), all said by J. H. Driberg (unpublished information) to speak dialects of one language. The position of the Dongotono is obscure, while Driberg considers the Lorwama to be a section of Lotuko-speaking Lango. (C G S)

BIBLIOGRAPHY.—D. Westermann, *The Shilluk People* (1912); N D H A MacMichael, *Tribes of Northern and Central Kordofan* (1912); *History of the Arabs in the Sudan* (1922). *Sudan Notes and Records* (1918). *See* also ARABS; BEJA; BAKKARA; BARABRA; NILOTES; BARI-SPEAKING TRIBES; LOATUKO, NUBA, THE; HAMEG; AZANDE, THE

## EAST AFRICA

The geographical area which is included under this designation extends roughly from the north frontier of Kenya Colony as far south as the Zambezi, and includes Kenya Colony, the Uganda Protectorate, Tanganyika Territory, Nyasaland and Portuguese East Africa.

We cannot say for certain who were the original inhabitants of this vast territory, for as yet our archaeological data are too scanty, but a number of tribes preserve in their mythology and legends recollections of what may have been a bygone autochthonous race. Thus the Akikuyu tell of cannibal dwarfs known as Maitoachiana, and both the Nandi and Masai have traditions of fantastically shaped ogres with cannibalistic instincts. Probably the nomads, who still exist under a variety of names wherever the natural conditions permit, represent the earliest inhabitants of whom we can have any knowledge. In this area they occupy a subordinate, almost a servile position, live by trapping and hunting, or by collecting roots and berries, are often shy, elusive creatures of the forest, rarely seen, and at other times are engaged in what their neighbours consider the menial task of blacksmiths, and always dreaded for their knowledge of poisons and witchcraft. Excluding these nomads, the races of East Africa fall into the following groups: (1) Bantu; (2) Nilotic; (3) Nilo-Hamitic. The Bantu are subdivided into Lacustrians and eastern Bantu. The classification is really linguistic, but happens to be sufficiently valid in this case as a cultural criterion. Thus by Bantu are meant all those peoples of Africa who use the root *ntu* or some similar word to express human being. *Ba-* is the plural personal prefix of which *mu-* or *omu-* is the singular. Thus we speak of *Muganda*, a Ganda person and *Baganda*, Ganda people. As the prefix is really redundant we shall refer to the Bantu tribes without the prefix and speak of Ganda, Nyoro, Swahili and so on.

The history of East Africa is the history of the Hamites, for the various groups are differentiated by the degree and nature of their Hamitization. The Bantu-speaking peoples are an early mixture of negroes and Hamites, and a series of later waves from the north-east, culminating in the great upheaval of the 16th century, of which the Galla expansion under Mohammed Granye and his invasion of Abyssinia in 1537 was a symptom, profoundly affected East African cultural relations. The Lacustrians were further Hamitized and a Hamitic autocracy imposed itself on many of the conquered Bantu peoples to the north and west of Lake Victoria. The Nilotics or inhabitants of the Nile valley, a parallel fusion of negroes and Hamites, with possibly a Semitic element added as well, were dispossessed of their tribal territories in what is now the south-eastern Sudan and were dispersed by invaders from the east. The bulk of them moved northwards and became the modern Shilluk, Dinka and allied tribes, but a few followed natural lines southwards, and to-day are known as the Acholi, Lango, Alur, Jopaluo and Jaluo. The invaders themselves were what are often known as "Half-Hamites," a rather meaningless term to which Nilo-Hamitic is preferable, as they are in fact increasingly Hamitized Nilotics. Southern Abyssinia and regions round Lake Rudolf have during the last 400 years witnessed a perpetual ebb and flow of immigrant peoples, more and more Hamitized, who were deflected by the Nile valley and moved southwards to populate the highlands of Kenya Colony and Tanganyika, until gradually the whole area from these highlands to the Horn of Africa was filled up with mainly pastoral peoples of Hamitic ancestry. This centrifugal movement southwards was

only checked by the intervention of western Powers in whose absence the process would undoubtedly have continued despite temporary checks such as the defeat of the Masai at the hands of the Bantu Hehe. This wedge of Nilo-Hamitics thrust southwards into Bantu areas appropriated the highlands to their pastoral requirements and separated the eastern Bantu from the Lacustrians The eastern Bantu were agriculturalists and content with the lower highlands and the coastal regions, but under the stress of isolation came very much under the influence of their Hamitic neighbours, and though linguistically they remain Bantu they have assimilated many of the characteristic features of Hamitic culture

The coastal belt and the adjacent islands, including Zanzibar and Pemba, are inhabited by the Swahili, whose language is morphologically Bantu and who are therefore generally classed as such Culturally, however, they are not homogeneous and have few Bantu affinities. Since Abdul Malik bin Muriani brought his Syrian builders in A.D. 659 to found his African kingdom, a succession of colonizing waves from Persia and from the Oman established a Mohammedan empire over the whole coastal region from the Lamu archipelago to the Zambezi. These immigrants brought their own culture, interbred with and assimilated the local Bantu at each of their administrative and trading centres. Thus was gradually formed the Swahili language, largely Arabic in origin, though structurally Bantu; and this was the genesis of what are now known as the Swahili people, or more properly the Swahili-speaking peoples, a heterogeneous conglomerate of localized dialects and customs, based on the original Bantu tribes who both assimilated the alien Mohammedan culture and incorporated in it no inconsiderable portion of their own. There were early Chinese voyages to the east coast of Africa, relics of which in pottery and coins, have survived on the coast from Lamu southwards. The Mongoloid eye found sporadically throughout this area, may also be a survival of Chinese infiltration, though other explanations are possible.

The Lacustrian and eastern Bantu meet in Tanganyika Territory and gradually the typical Bantu characteristics reassert themselves, though now we find a social organization with a more pronounced military bias than we encounter farther north. Typical of such tribal polities are the Hehe of Tanganyika Territory and the Yao of Nyasaland, whose organization, though much the same as that of their neighbours the Anyanja, is more closely knit and adapted to the exigencies of war. This may in part be due to the influence of the Angoni, an offshoot of the Zulu who fought their way north and penetrated as far as the southern shores of Lake Victoria. They were finally conquered by the Nyamwezi, a tribe also Zuluized and organized for military purposes, and were permitted to settle in their present homes. The Simba appeared on the lower Zambezi in 1540 and triumphing over the Portuguese and their African allies pushed north-east and succeeded in capturing Mombasa, before they were finally defeated and apparently annihilated near Malindi. The whole of this southern area has for centuries been the battle-ground of warring tribes, marching and counter-marching in almost inextricable confusion, achieving an evanescent eminence and as rapidly fading to comparative insignificance. Consequently there are fewer individual characteristics, the distinctions are less clearly cut, and their affinities are southern and western rather than northern. They belong to the southern Bantu more than to the Lacustrians despite the common characteristics which are part of the Bantu inheritance as a whole. The Thonga of Portuguese East Africa, for instance, very definitely merge into the southern complex and in Nyasaland the Anyanja extend into Rhodesia and come into contact with distinct Zambezi affinities.

In an area so complex and so full of cultural conflict it would be difficult to summarize the salient characteristics both briefly and adequately. Overlapping between the different groups is inevitable owing to the diffusion of cultural elements from one to the other and emphasizes the impossibility of a rigid classification. A fair picture, however, may be obtained of tribal cultures (social organization, mode of life and religious beliefs) by a concise examination of representative tribes in each group, with allowance for individual variation from the norm. The nomads require separate mention, and the Ganda and Ankole represent the Lacustrians The Nyika group represent the eastern Bantu. The Hehe and Angoni represent the fusion of the Lacustrians and the eastern Bantu with their southern influences Lango represent the Nilotics and Masai the Nilo-Hamitics

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(J. H. D.)

## WEST AFRICA

West Africa was inhabited in prehistoric times, ancient stone implements being found in Senegal, the Sudan, French Guinea, the Ivory Coast, Gold Coast and Nigeria, and sites are frequently found in the Sahara in regions now barren, but which no doubt anciently enjoyed different climatic conditions North Africa was probably peopled by men of Mediterranean race, then by Eastern Hamitic people (dark-skinned, fine features, soft hair), the modern Berber resulting from their admixture. Later came the Jews and Arabs. The Pygmies or Negrilloes, were pushed back by negroes from Central Africa, and were established in the area lying between the Sahara and the Gulf of Guinea and between the Atlantic and Lake Chad. Negrilloes and negroes at first interbred among themselves, then mixed with Berbers and peoples of Hamitic and Semitic stock, thus giving rise to higher grade peoples such as the Bornuan, Kanuri, Hausa, Mandingo, Yoruba and Ashanti.

**Principal Ethnic Groups.**—The following provisory classification rests on physical, cultural and institutional data:

I. White race: Berbers, Fulani
II. Black race: *a*) Senegalese-Guinea family
*b*) Nigerian Senegalese ,,
*c*) Volta ,,
*d*) Guinea ,,
*e*) Lower Nigerian ,,
*f*) Hausa ,,

**Social Organization: General.**—The social unit is the family in the strict sense, and more often the extended family, a group occupying the same enclosure whose members are divided into classes consisting of parallel generations having equal rights, with labour and ownership in common. Several related family groups form a village quarter. The distinct and organized clan is rare; more easily distinguished is the identity of the tribe and sub-tribe. Matriarchy is rare. Marriage is seldom exogamous, nearly always patrilocal; the children are attributed to the father, and descent is usually traced in the paternal line. Family authority devolves upon the father or the patriarch assisted by elders. Common ownership of family goods, with individual ownership of personal property, is almost universal. Women are usually at liberty to dispose of their own property. Succession to the family possessions, of which women form part, is vested sometimes in the brother and sometimes in the son of the deceased. On the Ivory Coast, in the Upper Volta and Nigeria, a husband allows his wife to cohabit with another man, the children belonging to him. Marriage between brothers-in-law and sisters-in-law is frequent. Personal possessions are heritable in the same way as family goods, but frequently men succeed to a man's goods and women to a woman's.

**Government.**—Many bush peoples (Liberia, Ivory Coast. Southern Nigeria) and peoples of the French Sudanese region (Gourounsi, Bobo, Lobi, Bariba) live in small independent groups. Elsewhere kingdoms have been constituted, very often theocratic in character and ruled over by a priest-king or by a king and a priest reigning together (Nigeria, Dahomey, French Sudan, Upper Volta) and uniting the civil and magico-religious power. Ministers and councillors assist the sovereign. The Queen-Mother (Gold Coast, Nigeria) possesses authority. The heir to the throne is often chosen, by an electoral group, from certain families according to local hereditary laws.

**Religion.**—Islam spread, in particular, over Mauritania, Senegal, the Guineas, the Niger valley, the Hausa country, Bornu and Nigeria; elsewhere, there is general belief in a supreme deity, in a sky and an earth god, and in inferior gods. Respect is paid to ancestors. Gods and ancestors share in the life of the social group. Various methods of divination are in vogue to ascertain their will. Infraction of certain sacred inhibitions (murder, the shedding of blood) are displeasing to the gods and are regarded as sins and require compensation and expiation. Family and clan cults are found, more rarely tribal cults. Sacrifices, frequently of a seasonal character (altars, trees, stones, hills, streams), insure fertility and fecundity, there being a close association between magic and religion. The head of the family is the domestic priest, and the descendant of the first occupant of the country is the priest of the earth. Sacerdotal colleges, male and female, are frequent (Dahomey, Ashanti, Yoruba). Traces of totemism are found in French Sudan, Ashanti, Dahomey, Nigeria. Numerous tribal, clan, family, individual, occasional and professional tabus, probably of totemic origin, are recorded.

Belief in witchcraft is general, the sorcerers being supposed to be able to change themselves into animals, injuries to the animal inflicted during the metamorphosis appearing on the sorcerer's body. There are special laws and punishments for sorcery.

Initiation of members of the social group is by successive degrees in secret ceremonies to adolescents, adults and men of full experience. They seclude the grades in the forest or in sacred groves. The neophyte is considered to have died and to have been reborn with a new personality, and receives instruction (moral, religious, technical, aesthetic). His position in the group depends on initiation. There are similar but less complicated ceremonies for women.

In Nigeria the king was frequently slain after he had reigned for a certain period, or when he grew old (Yoruba, Jukun, Hausa); the same custom appears to have existed in the French Sudan (Mandingo, Dogon).

Cannibalism and head-hunting have almost disappeared, but existed on the Ivory Coast, in Liberia, Dahomey and Nigeria. In former times human sacrifices were followed almost everywhere by a feast at which the victim was eaten. (H. LAB.)

## SOUTH AFRICA

The natives of Africa south of the Kunene, Okavango and Zambezi rivers fall into three main divisions, known respectively as Bushmen, Hottentots and Bantu. These divisions represent a series of successive waves of southerly migration by which the peopling of the country has been effected. The Bushmen, a race of short yellowish-brown nomad hunters, are the earliest human inhabitants of South Africa of whom there is any reliable historical record. Recent archaeological research, however, has established clearly that they were not the first to occupy the country, but are an invading people who superseded the original inhabitants of this part of South Africa. From the evidence afforded by their cultural remains it seems likely that at a very early time they occupied the hunting grounds of tropical East Africa and gradually passed southwards until, when the written history of the country begins, they were roaming all over the territory south of the Zambezi river.

By this time they were already being encroached upon by the Hottentots, who resemble them greatly in racial characters and in language, but are a pastoral people with a more complex material culture and social organization. The Hottentots seem to have sprung out of a mixture of the old Bushman population of East Africa with an early migration of Hamites from whom they obtained their cattle and certain elements of their language. They migrated south later than the Bushmen, and after crossing the upper waters of the Zambezi passed on to the west coast and down to the south coast, where they were found by the first Europeans to touch at the Cape.

The Bantu peoples are the latest of the native inhabitants to have entered South Africa. They all speak languages belonging to the characteristic Bantu language family of Africa (*see* AFRICAN LANGUAGES), but in racial characters they vary considerably, though certain negro characteristics predominate. They seem to have originated as a distinct variety somewhere in the neighbourhood of the Great Lakes and to have migrated South at various times between about the 12th and 15th centuries, each of their main groups (*see* below, *Principal Groups*) representing a different series of tribal movements.

The impacts upon one another of all these different peoples, and the later advance inland from the Cape of the European settlers, resulted in a complicated series of wars, migrations and extermination, in which the Bushmen and the Hottentots were almost completely broken up, while the original distribution and condition of the Bantu were profoundly disturbed (*see* SOUTH AFRICA, *History*).



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

A HAUSA HEADMAN

More Arab than negro, the Hausa peoples are intelligent, well developed physically and good traders

**Principal Groups.**—At the present time the Bushmen are confined to the Central and Northern Kalahari and neighbouring regions. They are there [illegible] in the southern portion, each speaking its own language (*see* BUSHMAN LANGUAGES), but as a result of intermixture with the neighbouring Bantu peoples they have to a great extent lost their purity of race. The Hottentots were formerly divided into four main sections—the Nama, Korana, Gonaqua and old Cape Hottentots—but of these the only relatively compact group to-day are the Nama, who are found chiefly in the southern half of South-west Africa. The others have either died out or completely lost their racial entity. The Bantu peoples, on the other hand, are still vigorous and powerful, and are increasing in numbers. They are divided into numerous small tribes which on the basis of cultural and linguistic differences, may be classified into the following groups:—

(*a*) Eastern, or Zulu-Xosa, which occupies the coastal region East of the Drakenberg mountains and South of the Sabi river. This group includes the so-called "Kafirs" of the Transkei (*i.e.*, the AmaXosa, AmaMpondo, AmaMpondomisi, and AmaTembu), the "Fingoes" of the Cape Province, who are the fugitive remnants of tribes broken up in Natal during the great inter-tribal wars at the beginning of last century, the Zulu peoples of Natal and Zululand, with their offshoot the Matabele (AmaNdebele) of Southern Rhodesia, the AmaSwazi of Swaziland, and the BaThonga (AmaTonga) and kindred tribes of Portuguese East Africa.

(*b*) Central, or Sotho-Chwana. This group occupies the greater portion of the interior plain North of the Orange river, and includes among many others the BaTauana about the Botletle river and Lake Ngami, the BaMangwato of North Bechuanaland, the degraded BaKalahari of the Kalahari desert, the BaKuena, BaNgwaketse, BaRolong and BaTlaping of Central Bechuanaland, the BaHurutse, BaPedi, BaKgatlha and kindred tribes of West and Central Transvaal, the BaVenda of the North East Transvaal and the celebrated Basuto of Basutoland.

(*c*) The so-called "Mashona" peoples of South Rhodesia, including the BaNyai or BaRoswi and the AbeNanswa immediately South of the Zambezi river, the MaKaranga (MaKalanga), WaManyika and BaZezuru of Mashonaland and the VaNdau of Portuguese East Africa.

(*d*) South-western, comprising the OvaHerero and the OvaMbo peoples of South West Africa. They are each divided into various tribes which between them occupy the northern half of the region between the Western fringe of the Kalahari desert and the Atlantic ocean.

Another distinct, though less important, division of the natives of South Africa is constituted by the Bergdama (Haukhoin), who inhabit the coastal region of South West Africa. Their racial history is still far from clear. Physically they are a true negro people, yet they are isolated far from others of their kind; they

live an extremely primitive life, and speak the language of the Naman, to whom they have long been in subjection.

**Social Organization.**—Both the Bergdama and the Bushmen have very simple forms of social structure Among the Bergdama the social units are small, independent local groups, each consisting of a patriarchal family, together with any relatives who may put themselves under the protection of its head, and sometimes including a certain number of dependent families who do not feel capable of founding a settlement of their own. The Bushmen are divided into small hunting bands, each of which owns a definite hunting territory over which it wanders and out of which it may not venture except with the permission of the neighbouring group. Within this territory members of the band are free to go where they like. The organization of the band is of the loosest kind. There is no chief, but skilled hunters and the older, more experienced, men in general have a great influence in directing social affairs. The only other structure of any importance is the family, consisting of a man and his wife, or wives, with their dependent children. Marriage within the band appears to be forbidden. A wife generally joins her husband's people, although in some of the northern tribes the young couple remain with the wife's parents until after the birth of the first child.

Of the Hottentots the only section whose social organization has been studied are the Nama, comprising several tribes, each of which has its own territory, name and chief. The tribe, however, is not a centralized body, but is made up of a rather loose aggregation of clans with the chieftainship hereditary in one of them. The authority of the chief is slight. The heads of the other clans act as his council, and he cannot do much without their co-operation. Each clan consists of a number of families claiming descent from some remote ancestor in the male line after whom they are named, and marriage within the clan is strictly forbidden. Polygamy was formerly practised, but monogamy is now the rule.

Among the Bantu peoples considerable variation exists in details of social organization, but certain general features prevail. Each tribe occupies its own territory under its own chief. His authority is generally considerable, but his actual power is somewhat modified by a council consisting of some of his relatives and the more influential heads of families. The family or household group is always of great social importance. It is normally polygamous, and generally forms a distinct local unit, except among the central tribes, where there is a tendency for different household groups to collect together in villages. Even here, however, each household is distinctly marked off from the rest. Within the household each wife has her own hut; and with her children constitutes an economic unit with well defined legal rights. Marriage is patrilocal, and is legalized by the payment of a bride-price (*lobola*), generally in the form of cattle. There exists also an organization of the people into clans, which, except in the eastern group, are associated with totemism. Clan exogamy is customary, but does not obtain among the Sotho-Chwana tribes. Membership of the clan is determined by descent through the father, except among the OvaMbo, who are matrilineal people, while the OvaHerero have a double system of clans, one set with patrilineal descent, the other with matrilineal (*see* later, *General Features of Note*).

**Mode of Life.**—Levels of culture differ considerably. All the Bushmen in their original condition are hunters and collectors. They practise neither agriculture nor pastoralism, but derive their subsistence entirely from the game they hunt and from the wild vegetable foods which the women collect. Their chief hunting weapons are the bow and small arrows with detachable poisoned points, but they also make use of throwing-sticks, pitfalls, traps and snares of all kinds, while the women have pointed digging-sticks, which are sometimes weighted with perforated stones. They are a nomadic people, confined in the dry season to places well supplied with water-holes, but, when the rainy season comes, wandering about freely within the limits of their hunting territory. Their encampments are temporary, and their dwellings crude shelters of rush or reed. The Bergdama on the whole lead a similar mode of life, although many of them also keep goats.

The Hottentots are chiefly a pastoral people, with herds of long-horned cattle and flocks of fat-tailed sheep. Sour milk forms a staple element of their diet; and in contrast to all the Bantu except the OvaHerero, it is not the Hottentot men, but the women, who do the milking. Hunting also plays an important part in their economic life, their methods of hunting and their weapons being practically identical with those of the Bushmen. To some extent they are also nomadic, as fresh pastures for their herds are necessary from time to time. Their encampments, however, are less impermanent than those of the Bushmen. They live in beehive huts, covered with reed mats, and their settlements are arranged in circular form, leaving in the centre an open space in which the cattle are collected at night. Their material culture is on the whole superior to that of the Bushmen; in particular they smelt iron for the manufacture of their implements and weapons, while the Bushmen barter with the neighbouring Bantu peoples for whatever iron they require.

With the exception of the OvaHerero who are a purely pastoral people, all the Bantu tribes practise both hoe-culture and pastoralism. The eastern tribes are more predominantly pastoral, the others more agricultural, but all have this combined means of subsistence. Each household group has its own cattle and goats, as well as its own fields. The cattle are the concern of the men (except among the OvaHerero, where the women do the milking), the fields that of the women. The food supply is derived mainly from sour milk and from crops of millet and maize, supplemented in minor forms by pumpkins, peas, beans, etc., while for meat they rely chiefly upon the game hunted by the men. Cattle are never slaughtered for food except on ceremonial occasions. The life of the people is more or less sedentary. The eastern and south-western tribes live in beehive huts of thatch, the central and Mashona tribes in circular huts with conical roofs. The settlement is always arranged on the circular principle already noted among the Hottentots. All the industries are essentially domestic, practically everything required by the household being made within it. The one exception is in the case of iron implements and weapons, for which there are special workers, who barter their products for cattle and grain.

**Religion, Special Features.**—In religious beliefs there are certain fundamental features which appear to be common to both the Bushmen and the Hottentots, but there is also considerable variation in several important details All Bushmen pray to the moon and other celestial bodies, and have an extensive series of myths and legends relating to them. They believe also in certain mythical beings, known variously to different tribes as Cagn (the mantis), Huwu, Tora, Gauna, etc., who appear to be personifications of natural forces, especially those producing the rain, and are frequently invoked. These mythical beings are credited with creative powers, and are met with in various myths of origin. From references in their myths and folk-tales it appears that the Bushmen have further a well developed system of ritual relating to animals and other sources of food, but it is not known in any detail what that ritual is or was. There seem also to be certain beliefs and practices connected with the spirits of the dead, but concerning these the information available is vague.

The religious cult of the Hottentots seems in general to consist mainly in the worship of mythical heroes derived partly from animistic beliefs and partly from the personification of the natural forces producing rain. In their general attributes these beings, chief of whom are Tsui-goab, Heitsi-Eibib and Gaunab, strongly resemble those of the Bushmen. The worship of the moon also seems to have been prevalent among the Hottentots at one time, judging from the records of prayers made to it for food and rain. There is further an extensive ritual relating to the cattle, which, as the chief source of food, are of paramount importance to the well-being of the community; while water, another extremely important factor in the economic life of the Hottentots, also plays a part in numerous ceremonial performances and taboos. One of the chief functions of the medicine-men, as among the Bushmen, is always the making of rain.

Among the Bantu, the religious cult is very largely a strongly developed form of ancestor worship. This is primarily a domestic cult, each family through its eldest male representative worshipping its ancestors in the male line. On important tribal occasions

the chief also prays to his ancestors on behalf of the tribe as a whole. The ancestors are regarded as guiding the destiny of their living descendants, and are propitiated by means of sacrifices offered on ceremonial festivals such as birth and marriage and on other special occasions. All the Bantu have also some conception, often rather vague, of a power in the universe which is not connected with the ancestors. This power is often associated with the sky, but shows itself most impressively in the phenomena of the weather, and hence rain, lightning and thunder are considered its manifestations. It is also sometimes looked upon as the creator of all things and the moulder of destiny. It is met with under various names (such as Tilo among the BaThonga, Unkulunkulu and Inkosi among the Zulu, Modimo in the central tribes and Nzame among the OvaMbo), and the beliefs and customs relating to it differ considerably from tribe to tribe. There is further an extensive ritual relating to agricultural life and to the cattle (the OvaHerero have a sacred herd of cattle), while traces of a totemic cult are found in all the tribes except the eastern. Magic and witchcraft play an extremely important part in the lives of the people, and in connection with this shamanism has developed to a high degree, so that there are many different kinds of medicine men with special functions, such as rain-making, divining, "doctoring" the crops, purifying the army, healing disease, etc.

**General Features of Note.**—In physical appearance there are many features which readily distinguish the Bushmen from all other inhabitants of South Africa, save the Hottentots. They are typically short in stature, but not dwarfish. Their limbs are slight and finely shaped, the hands and feet being especially small; but there is a curious curvature of the spine which gives a great prominence to the buttocks, where also a great accumulation of fat (steatopygia) sometimes occurs in the women. The skin is yellowish-brown in colour, and wrinkles very easily. The hair is woolly and sparse, commonly very short, and is scattered on the head in little tufts, or "peppercorn" fashion. The head is small and markedly low in the crown, the face broad, with prominent cheek bones, bulging forehead and convex upper lip, the nose extremely flat, the eyes narrow and often slightly oblique; frequently there is no lobe to the ear. In the more northern and eastern tribes there is a distinct tendency towards greater stature, darker colour and better muscular development, while the head and face are longer and higher. These divergent characters are the result of intermixture with the neighbouring Bantu peoples.

The culture of the Bushmen is noted for the highly artistic paintings and engravings which they executed on the walls of caves and rock-shelters. The subjects portrayed are chiefly animals, human beings, hunting, battle and dancing scenes, and the representations are remarkable for their fidelity to nature. The practice of the art seems to have died out, but it proves a most important link in the chain of evidence connecting the Bushmen of South Africa with the Palaeolithic cultures of the peoples of Europe.

Of the social customs of the Bushmen, especially those connected with birth and marriage, little is known. Initiation ceremonies at puberty are common to all Bushmen. On reaching her first menstrual period a girl is secluded in her hut and has to observe various food taboos. In the northern tribes a special religious dance, known as the "eland bull" dance, is added in her honour. Initiation ceremonies for boys seem to be restricted to the northern tribes. The special tribal marks are cut by the medicine men between the eyebrows of the boys, who are then kept in a secluded spot for about a month. During this time they are instructed in the lore of the tribe, and religious dances are held in which animal masquerades predominate. The Tati Bushmen practise circumcision as part of the initiation ceremony, but they are the only Bushmen of whom this is known, and have probably adopted the custom from the Bechuana among whom they live. At death the corpse is usually buried lying on one side with the knees drawn up against the breast. The group then removes to another site.

The Hottentots resemble the Bushmen closely in appearance, and it is only in certain characters that there are any noticeable differences. They are taller than the Bushmen, and have distinctly longer and narrower heads. Their skull is also higher and the face more prognathous. They have, however, the same prominent cheek bones, small chin, flat nose and peculiar eyes as the Bushmen, while their ears are often also lobeless. Their hair and their skin colour are the same as in the Bushmen, and steatopygia is often more marked.

An important feature in their culture is the great prominence of the communal meal in their ceremonies. It is a means of curing a sick person by aggregating him to the group of those who have had the disease and recovered; of introducing young men and women to the life of full members of the tribe; of bestowing on a young mother the solidarity of the group of mothers with strong and healthy children; of welcoming a widow, or widower, into the group of the widowed, and so giving them a new place in the society as a whole. The part water has come to have in their ceremonial life because of its extreme value in their economic life is also noteworthy. In addition to there being a great annual rain-making ceremony, water plays an essential part in many religious ceremonies, is endowed with a special protective power in some cases, and is considered extremely dangerous in others. Rain, as the source of water, is also held sacred, and the natural forces producing it are even personified and worshipped.

The Bergdama are of considerable interest, as they appear to be the most primitive negro people known, apart from the Congo pygmies. They are of medium height, strong, even coarse, build, with long rather thick skulls, prognathous faces, broad noses, very dark, even black skin, and all the features typical of the true West African negro. What their original language was is not known, for they have been so long enslaved by the Hottentots that they have completely adopted the Hottentot language. Yet in ceremonial their lives appear to have been but little influenced by the Hottentots, and among them there is found what appears to be a very important feature of many Bantu cultures, the sacred fire round which the whole life of the society centres. Each little group has a sacred fire which must never be allowed to go out, but which must be guarded day and night by the chief wife of the patriarch. Day by day, when the members of the group go out to seek for food, the head of the group and the old men sit guarding the fire, and as long as that is aglow and respected by all, the hunters and collectors will find food for the day. All game must be laid by the sacred fire, and certain portions of it must be eaten ceremonially by the elders of the group. Each kind of berry and root, as it ripens, must be brought to the sacred fire before it can be eaten. All good, all evil hangs upon the guarding of the fire from all impurities, which come from breaches in the regulations as laid down in the traditions of the tribe.

Racially the Bantu peoples present a great variety of types. They are fundamentally negro peoples, mixed with Hamitic, negrillo and other types. The skin is usually less dark, stature lower, head less elongated, forehead flatter, prognathism less marked, nose generally more prominent and narrower than in the true negro. The Hamitic strain often shows itself clearly among the Zulu and allied tribes in a relatively narrow nose. The hair is uniformly of the ordinary negro type, the skin all shades from yellowish-brown to the black of the AmaSwazi, usually a reddish ground tint, dark chocolate colour being the prevalent hue. The Eastern tribes are on the whole taller and more dolichocephalic than the Central, while the South-western tribes are more typically negro than the rest.

The political organization of these peoples is well developed, and they have an elaborate system of laws regulating their social life. Among the OvaMbo blood revenge is still practised, but among the Central and Eastern tribes the tribal authority is supreme. All members of the tribe are regarded as belonging to the chief; an injury to them is, therefore, an injury to him, and compensation for death or injury must be paid to him. The Ama-Zulu and AmaXosa are renowned as fighting tribes, none of the rest being specially war-like; and among the former a strict disciplinary system was established by the great chief Chaka, who abolished the throwing spear, which is the typical weapon of this area, and introduced the short stabbing spear. By this reform he forced upon his warriors the necessity of coming to close quarters,

and from that time the Zulu became a dominant people and were able to found and develop a great military kingdom in South East Africa.

The initiation ceremonies at puberty of the Eastern and Central tribes are of some importance. The boys are initiated in groups, which are kept secluded in a special "lodge" for about three months, during which they are taught their tribal history, the moral and religious code of the society and its social etiquette. The ceremony itself consists in circumcision, performed by a special medicine man. These initiation "schools" are held every year in some tribes, in others at intervals of from four to five years. In each case the group of initiates is usually given a special name by which it is known throughout life. These groups play an important part in the tribal organization, and form the nucleus of the military system The Zulu do not have initiation schools, nor do they practise circumcision, but the system of initiation groups has persisted in the formation at regular intervals of military regiments comprising boys of about the same age. Girls are also initiated in groups at the time of puberty, and are not considered marriageable till they have passed through the ceremony.

The Central tribes have remains of a tribal totemism. Each independent section of the people, which may at one time have represented a clan, has a *siboko* or laudatory name, taken from some animal or some natural phenomenon. In former times there was a definite ritual connected with the species of animal so used. Nowadays, however, the main division of the people is into patrilineal clans, and the possession of a common *siboko* is no bar to marriage. In the Eastern tribes all traces of totemism, if it was ever present, have disappeared. They are all divided into clans each with its own *isibongo* (laudatory name) which is generally the name of the ancestor from whom the clan is thought to have sprung. Marriage between people with the same *isibongo* is not permitted. Very often, however, a clan will split up, a younger branch taking some more immediate ancestor as its *isibongo,* while the older branch preserves the more ancient *isibongo,* and intermarriage between the two branches is then permissible.

The OvaHerero clan system is a combination of the patrilineal and matrilineal systems. The people are divided in the first place into clans with matrilineal descent, called *eanda,* and then into clans with patrilineal descent, called *oruzo.* Every person belongs to the *eanda* of his mother, and the *oruzo* of his father. Both the *eanda* and the *oruzo* are totemic and exogamous. Each of these clan divisions has a different function. The *eanda* is associated with economic relationships, so that inheritance is in the female line. The religious life, on the other hand, is almost entirely connected with the *oruzo,* and is a developed form of ancestor worship, so that a man prays always to the ancestors of his father. Here again, the sacred fire is very prominent. At the chief's village the ancestors of the chief are worshipped, and represent the ancestors of the whole tribe. In addition the sacred fire is found in the kraal of each head of a family, lighted, in the first instance, from that of the chief. None of these fires must ever be allowed to go out. To this fire the women bring the milk each night and morning to have it blessed by the kraal head and the ancestors.

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## ARCHAEOLOGY AND ETHNOLOGY

The boundary between Negro Africa and "White" Africa, *i.e.,* Egypt and the northern and north-western portions of the continent, must be both conventional and provisional. The explorations of Reisner at Kerma in Nubia (between the third and fourth cataracts) and of Garstang at Meroe, have carried Egyptian influence so far south in the Nile valley that these sites, although inhabited by peoples of mixed culture, must from the archaeological standpoint be referred rather to Egypt than to the Sudan.

No such line of division exists in the west between the North African cultures and those of negro-land; indeed Gautier ("Études d'ethnographie saharienne," *L'Anthropologie,* 1907) has shown that there is good reason to suppose that the latter has advanced perhaps as much as 1,000 km. at the expense of the former, during the last 2,000 or 3,000 years. Moreover, Meroe itself does not accurately represent the southern limits of the mixed civilization to which it has given its name; some 12 mi. south of Khartum on the right bank of the Blue Nile are the remains of Soba, a Meroitic site, later the capital of the Christian kingdom of 'Alwa (the Alut of the hieroglyphs), which Meroitic remains have been recently discovered 200 mi. south of Khartum.

Yet Meroe, which lies in the neighbourhood of the 17th parallel of north latitude, may well stand as the main southern bastion of Egyptian influence, and the area with which this writer will deal is that part of Africa lying south of 16° north, which will be divided into three provinces, eastern, western and southern.

The Nile-Congo watershed, a natural feature of geographical and ethnic importance, constitutes part of the dividing line between the eastern and western areas, which continues northwards along the broad ridge of relatively high land that roughly divides the territories of the Anglo-Egyptian Sudan from those administered by France. Thus the boundary line somewhat closely follows the western confines of Darfur, while south of the Nile-Congo watershed it coincides with the boundary between the Belgian Congo and British territories to the east, both eastern and western provinces being limited to the south by a line roughly following the 10th parallel of south latitude.

### THE EASTERN PROVINCE

**Palaeolithic Artifacts.**—Here discoveries have so far been limited to the Sudan, Uganda, Somaliland and Kenya Colony, while surprisingly little is yet known of the early pre-history of even these territories. Except possibly in the extreme north, within a few miles of Halfa, no implement of River-drift type is known to have been found in the Sudan. This fact may be due to incomplete exploration, but is of some significance considering the abundance of specimens which have been found on the surface in Egypt and Libya, in Somaliland (where H. W. Seton-Karr has collected countless specimens of River-drift and Mousterian types), South Africa, and recently, in deposits, by Wayland in Uganda, though the majority of the implements he discovered are perhaps to be associated with the Le Moustier *facies* rather than that of the River-drift. Be this as it may, Wayland has collected Chellean hand-axes in gravels, considered of Pleistocene date, capping quartzite hill-tops some 300ft. above the present level of the lake, and also implements of a well-developed Mousterian type, including "points, side-scrapers, flake knives, tortoise cores and tortoise points," as well as two typical side-scrapers in a cave under some five feet of cave earth. (A. A. Smith and E. J. Wayland, *Some Primitive Stone Implements from Uganda;* Uganda Protectorate, Geological Survey Dept., 1923.)

No typical Mousterian specimens have yet been found in the Sudan, but certain specimens collected from two sites, namely, Jebel Katul in north-west Kordofan, and Jebel Gule in Dar Fung, are considered by the Abbé Breuil to belong to the Mousterian period. So far as is known no implements attributable to the latter part of the Palaeolithic age have been found anywhere in the Eastern Province, certain pygmy implements which will be mentioned later being regarded as Neolithic. (C. G. Seligman, "A Neolithic Site in the Anglo-Egyptian Sudan," *J.R.A.I.,* vol. 40, 1910.)

river, there were found bones, including skulls, probably representing burials disturbed by flood, and some of these bones are definitely fossil. Here the skulls are of more than one type, (1) strongly built, dolichocephalic, and, apart from the lower jaw, somewhat resembling the Combe Capelle skull, (2) smaller, brachycephalic, represented only by women. The associated industry consists of fair-sized flakes, lunates and end-scrapers of obsidian, ostrich-shell beads and pearl shell pendants, as well as at least three types of pottery. Besides the effects of flood this site was disturbed some ten years ago, so that the original stratification may have become confused and the associated objects be of different ages.

### THE WESTERN PROVINCE

**Palaeolithic Remains.**—It is only recently that stone implements of River-drift type, and therefore to be regarded provisionally as of Palaeolithic age, have been discovered in West Africa In the British Museum there is a series of massive implements of Chellean type, consisting of quartz porphyry, which on the surface have weathered to the softness of chalk. These come from the alluvial deposits of the Bauchi plateau, as do a smaller number of implements of Mousterian type of the same mineral, and one very steep end-scraper of a more homogenous stone showing no surface weathering. (These implements are described by H. J. Braunholtz in *Occasional Paper* No. 4 of the Geological Survey of Nigeria.) There is also in the national collection a number of short stumpy implements of Drift type of a reddish quartzite, for the most part with unworked butt, found on the golf links of Accra (Gold Coast). Similar specimens have been found in the local gravels, the actual specimens in the museum having apparently been washed up from the beach.

**Neolithic Age.**—Polished axe-heads of ordinary Neolithic type are by no means uncommon in West Africa and the Congo valley. They are found in Northern Nigeria, especially in the Bauchi Plateau gravels, where it is said that they overlap to some extent the Drift types. They are, however, of a different stone, for the most part of dolerite. In the Gold Coast Colony they are found in large numbers, as are perforated quartz discs, while a few bossed spheres about 2in. in diameter, of anomalous appearance and unknown use, have been recovered. A collection of Neolithic implements from Calabar include stone axes, unusual in that they possess a definite tang for hafting.

Under the title "Tumbakultur" Oswald Menghin (*Anthropos.* 20, 1925) has described a culture characterized by series of implements, widespread in the Lower Congo area, which he tends to approximate, though with difficulty, to the Campignian of Europe. Be this as it may, Menghin finds a long series of artifacts passing insensibly from implements of coup-de-poing type, Campignian *pics,* flattened ovates of almost laurel-leaf type, to notched and roughly cruciform spear or arrowheads, some, though larger and coarser, irresistibly recalling the "freak" forms from Breonio in Italy. Apart from these, many ground stone axes have been found in the Congo area.

**Megalithic Monuments.**—Megalithic monuments are distributed widely in West Africa in the form of stone circles and standing stones. In Gambia both classes of monuments have been carefully described by the late Henry Parker in a paper published after his death (*Jour. Roy. Anth. Inst.,* vol. 53, 1923):—

"The circles themselves are generally found in groups or clusters comprising from two to nine, but single circles are met with. With one possible exception there are no uncompleted circles, except those formed by concentric outer pillars standing round an inner circle. . . . The groups of circles are arranged in single straight lines; in nearly parallel lines consisting of two, three or four circles; or in pairs; but never in triangles or pentagons. Many stones are prostrate and . . . almost invariably these fallen pillars . . . are at least partly buried by the soil. . . . Some have their upper face almost level with the ground, and as a rule the others are half or three-quarters covered by the earth. . . . Superficially considered this is the only indication of the age of these structures, and . . . it would be of great value if we knew the rate of elevation of the soil. Without such knowledge it is only possible to draw the conclusion from this evidence that both the circles and the menhirs must have been erected many centuries ago.

"In addition to the concentric outer pillars, there are several instances where the outer pillars are arranged on the eastern side of the circle in a straight line, or even in two parallel lines, in a north and south direction. Such lines are invariably to the east of the circle. . . ."

The circles are considered sacred to the Earth Spirit, and ceremonies are performed in them to propitiate the latter, as also for the protection of the crops. It does not, however, appear that Parker excavated in them, and their date and purpose must be left for further exploration, though in the light of information received on the spot the contents of the circle (human remains, spearheads, copper armlets) dug by J. L. Todd and G. B. Wolbach (*Man,* No. 96, 1911) suggest that in recent times these monuments were the sites of sacrifice for success in warfare.

In some of the northern villages of the Cross River Division of Nigeria, *i.e.,* in the villages of the Akayu, Indem and Atam districts (on the left bank of the Aweyong river) there are stone circles, the stones often more or less conical and carved to represent the human body from the waist upwards. These have been described and figured by C. Partridge (*Cross River Natives,* 1905, pp. 268–599); the navel is specially prominent, and cicatrices seem to be reproduced. At Agba village the circle surrounds an old tree, and the grove of the great chief who erected the circle. The tree is sacred, and of the stones it was said by the ancestors "these stones are your forefathers, your very great chiefs; every year you must sacrifice to them" (p. 271).



BY COURTESY OF THE PRESBYTERIAN BOARD OF FOREIGN MISSIONS

WOMEN SERVE AS CARRIERS IN AFRICA, COVERING 35 MILES A DAY

**Beads.**—In the past, claims of high antiquity have been made on behalf of the so-called "aggry" beads that have been found in West Africa. Yet as stated by Sir Hercules Read, with the single exception of the necklace to be discussed immediately none of these beads shows features not to be found in mediaeval or later beads from the factories of Venice. The necklace, presented to the British Museum by L. P. Davies, was obtained from the grave of "a renowned chief" at Mansu, a town on the route from Elmina to Kumasi. It is described in detail in *Man* (1905, 1).

For present purposes interest centres in some 20 beads of crystalline glass, irregular-faceted, and especially one bead of crystalline glass moulded like a mulberry. Sir Hercules Read writes of these as being in a state of iridescent decay, the surfaces being in many cases deeply pitted and presenting exactly the same appearance as beads of the same kind from the Mediterranean area. He points out that the crystalline glass in this necklace is identical in appearance with those from the tombs at Kameiros in Rhodes, dating from the 6th century, and goes on to suggest, but "without insisting too strongly on this point," that here are "glass beads of classical style found for the first time in West Africa, and presenting features that in point of date may justifiably be associated with the name and time of the Carthaginian Hanno, a name often invoked when objects of indeterminate age are found on the African coast."

Though probably not of any great age, reference must be made to the soap-stone carvings of human heads or figures (occasionally animal figures) found in the ground, sometimes apparently in pits, in certain districts of Sierra Leone, where they are used as agricultural charms. These figures are for the most part roughly carved, the work being well within the scope of present-day Africans, and Joyce (*Man,* No. 57, 1905, and No. 40, 1909), points out that there is really no reason to see in them—as has been proposed—evidence of foreign, *i.e.,* Egyptian or Carthaginian influence. The objects described by Frobenius from Old Ife (*The*

*Voice of Africa*, 1913, vol. i, chap. 14; "The Archaeological Finds"; and *Das Unbekannte Africa*, Munich, 1923), the ancient capital of the Yoruba, are also probably of no great age, there do not seem to be any which the 16th century Benin civilization might not have produced.

Possibly of about the same date are a number of bronze and silver objects, now on depôsit in the British Museum, from a sandy mound (no doubt a grave) at Tumuni in the Sokoto Province of Northern Nigeria. Sir Hercules Read holds that they exhibit features and analogies which are unusual in negro African metal work, pointing to artistic or commercial relationship with the culture of the Mediterranean area, doubtless at a period remote from the date of the manufacture of the relics themselves.

The most important pieces are a bucket with incurved sides and lugs, and a barrel-shaped armlet (?) for wear on the bicepital region. The lines and casting of both, and the geometrical patterns tooled on their surfaces, are good and careful work. While the find as a tomb-group may date to A.D. 1480, as suggested by H. R. Palmer, yet, as stated by Read, they are of unusual interest from the analogies they present with the early Mediterranean cultures, and we may have here a distant echo of the early art of the Bronze age. At the same time there is no reason to think that the actual objects are anything but local productions, though they may differ from those of more recent date

### THE SOUTHERN PROVINCE

**Palaeolithic Implements.**—Artifacts of rude Chellean type, often larger than the corresponding implements of western Europe, are found over the greater portion of South Africa, nor does there seem to be any reason why these should not be regarded as true palaeoliths perhaps of an age comparable to those of Europe. One of the most satisfactory finds of this order is constituted by a considerable number of implements of chalcedony, quartzite, etc., exactly similar to types characteristic of the River-drift Period of western Europe and Great Britain, associated with and evidently forming part of ancient terrace gravels deposited as drifts by the Zambezi (in the neighbourhood of Victoria Falls) at a remote period. The position of these terrace gravels and surface drifts in regard to the Batoka Gorge indicates their real antiquity, since they must have been deposited by the river when the latter was covering the old valley floor more than 400ft. above its present level. Here Henry Balfour excavated several implements from undisturbed gravel deposits at depths varying from 6in. to 2ft., some greatly water-worn and heavily patinated.

Recently A. J. H. Goodwin ("South African Archaeology," *Man*, 1927, 14, and "Capsian Affinities of S. A. later Stone age Culture," *South African Journal of Science*, vol. xxii., 1925) has summarized South African history on the following lines:—

The terms Palaeolithic and Neolithic are dropped, the two main periods being termed the Earlier Stone age and the Later Stone age, Péringuey's name for the main *coup-de-poing* culture of the Earlier Stone age, the Stellenbosch industry, being retained. A second culture, the Victoria West industry, centres round Victoria West in the south-central Karroo, running north into the Free State and west to Nakob on the S.-W. African border; the *coup-de-poing* occurs, but the main implement appears to be a core similar to the European Acheulean tortoise-core, but some 8in. or so in length. It is not clear whether core or flake was the desired element, but secondarily worked flakes of this industry have not been found. The last culture of the Earlier Stone age is that of Fauresmith in the Orange Free State, with a flake worked to resemble a *coup-de-poing* as the characteristic tool.

There is no evidence of the Earlier Stone age developing into the Later Stone age, indeed they probably overlapped. The earliest industry of the Later Stone age is that of Still bay (near Mossel bay) covering most of the eastern part of the Union and extending into the Free State and to Okahandja in South-West Africa. This culture somewhat resembles the Solutrean of Europe, with lanceolate implements (usually small) as well as tanged forms, sometimes with serrated edges.

The Still bay culture was followed by two probably contemporaneous industries which extend into modern times, termed from sites in the Orange Free State the Smithfield and Wilton cultures respectively. The Smithfield culture includes end-scrapers, thumbnail and horse-shoe scrapers, trimmed points (of Chatelperron type), handpicks, bored stones, ostrich eggshell beads, ground stone rings, pottery and human remains. The human remains are of the "Bushman" type, and in a general way this culture is similar to the Capsian or the Aurignacian of Europe. The Wilton industry is very similar; the chief implements are pygmy lunates, thumbnail, and end-scrapers, as well as geometrical forms; the pottery is similar to that of Smithfield; bone arrowheads and link-shafts occur; burials are flexed, with skeletons of the same general type as the Smithfield specimens Slate "palettes" are also found, and the culture is definitely associated with the cave paintings. Goodwin considers this culture as identical with the last phases of the Capsian of Spain and North Africa, a point of view confirmed by I. Schapera ("Some Stylistic Affinities of Bushman Art," *South African Journal of Science*, vol. xxii. Nov. 1925, pp. 504–15), who, as the result of a careful comparison of European Palaeolithic and Bushman art concludes that the Capsian art of Spain shows most affinity with that of the Bushmen.

Information supplied by Goodwin indicates the existence of a true Mousterian—the Glen Grey industry—with high-backed as well as the more usual flat points similar to those found in North Africa and Europe, while in the Later Stone age the recent discovery at Howieson's Poort of a number of true graving points (*burin*) is important, both in itself and as further suggesting contact with the north.

**Pottery.**—It is not clear that examples of pottery of any considerable age exist. Those figured by Péringuey (*Annals of the South African Museum*, vol. viii, 1911), provisionally assigned to Bushmen, Strandloopers and Hottentots, are of the rudest type, predominantly ovoid with conical bottoms, sometimes ornamented, the kneading and baking being very poor.

**The Bushmen.**—No apology seems necessary for considering the "archaeology" of the Bushmen with that of the kindred Strandloopers (no longer to be regarded as a distinct race, the name describing a mode of life and not implying a constant physical difference), for even though the former are not utterly extinct, the few survivors no longer pursue their characteristic arts of painting and graving on rock. It is generally admitted that the Bushmen stock came into South Africa from the north, and Stow was of the opinion that there were two great divisions, each with its characteristic mode of life and art, viz.: (1) cave-dwellers (painters), and (2) kopje-dwellers (sculptors), the latter producing their works by "pecking" the rock face on which they worked. This view does not seem to be generally accepted, perhaps it only emphasizes differences in technique due preponderantly to environment.

The paintings of the Bushmen, naturalistic monochrome and polychrome studies of high artistic merit, for the most part record the animals which they hunted and upon which they subsisted. But paintings of the carnivora are not absent, and cattle raids, dances and magico-religious (?) scenes are also portrayed. Belonging no doubt to the latter class are the fairly numerous examples of animal-headed human figures—representations of masked dances—not to be confused with the wearing of animal skins as a hunting ruse to admit approach to the game, as in the famous picture in the Hershel district of Cape Colony of a Bushman wearing an ostrich skin while stalking a flock of these birds.

The character of Bushman paintings has been well summed up by Henry Balfour:—

They are "remarkable not only for the realism exhibited by so many, but also for a freedom from the limitation to delineation in profile which characterizes for the most part the drawings of primitive peoples, especially where animals are concerned. Attitudes of a kind difficult to render were ventured upon without hesitation, and appreciation even of the rudiments of perspective is occasionally to be noted, though only in a crude and uncertain form. The practice of endeavouring to represent more than could be seen at one time . . . is far less noticeable in Bushmen art than might have been expected from the rudimentary general culture of these peoples, and one does not see instances of *both* eyes

being indicated upon a profile face, or a mouth in profile on a full face. . . . The colours were usually laid on uniformly over the surface which they individually covered, but a shading off is sometimes exhibited" (*Bushmen Paintings,* 1909, p. 9.)

Dr K. M Barnard points out that examples similar in execution to those described by L. Péringuey (*Trans. S. Afr. Philos. Soc.,* 16, 1906, and 18, 1909) have been discovered at various places in South-west Africa, the farthest north being in the Grootfontein district. In addition to the usual animals there are representations of the human foot, and the spoor of various bucks, while from the position in which these latter occur the explanation that they are "sign-posts" to water cannot be maintained

Major F. J. Bagshawe (see *Man,* 1923, 92) has discovered in Tanganyika Territory rock-paintings of Bushmen type of so high an artistic quality that their origin can only be referred to this race, an extension northwards which goes well with the distribution of the Bushmen *kwe* (digging-stick weight), of which specimens, known in Tanganyika, have been discovered in Uganda (Wayland) and even among the Bari of the Southern Sudan (Seligman). The Tanganyika rock-paintings include an eland, cow, ostriches, giraffe and antelope.

**Strandloopers.**—The Strandloopers are a people of whom, apart from their skeletal characters, we know little, though concerning these there is a fair volume of reliable if not always consistent data. Their cultural attainments may be judged, *e.g.,* from the remains found in the caves and rock-shelters of T'zitzikama cliffs, about 100m to the west of Port Elizabeth One of these shelters explored by F. W. Fitzsimons (described by Sir Arthur Keith, *The Antiquity of Man,* I, 1925), contained deposits some 30ft. deep. The lower 5ft. and the upper 6ft. were sterile; below this latter layer was a stratum some 7ft. thick in which numerous Strandlooper burials were encountered amidst remains of fireplaces, broken pottery, implements and ornaments in stone and bone. Then came the third stratum, over 6ft. in thickness. While removing this stratum and working at a depth of 15ft. below the original floor of the shelter, Fitzsimons found graves containing remains which differed from those he had met with in the stratum above. Unfortunately the bones in the lower stratum were imperfectly preserved. The graves had been partly protected by slabs of stone some of which had been rudely engraved with human figures. There were lumps of red ochre, necklaces of shell and bone and tools of stone and bone. In a still deeper stratum, also about 6ft. in thickness, there were traces of burials and hearths, the human remains being fragmentary, but considered to belong to individuals of the Boskop type.

**Mediaeval Remains in Rhodesia.**—The conclusions of D. Randall-MacIver (*Mediaeval Rhodesia,* 1906) that the Zimbabwe and similar ruins in Rhodesia are negro in origin and modern in date, though not generally accepted in South Africa, have not been disproved. For though there is no inherent improbability in the early Semitic origin of these ruins, it seems unnecessary to seek a foreign colonization where the facts in no way contradict a local origin. No authentic inscriptions have been found, and no objects discovered in the Great Zimbabwe, around which the controversy has chiefly centred, need be more than a few centuries old, while those that are not foreign imports (porcelain, etc.) are of African type. Moreover, a re-examination of the evidence, including unpublished material in the library at Lisbon, has led Father Schebesta (*Mitt. der Anthrop. Ges. in Wien,* 1922–23) to the conclusion that not only is the Zimbabwe a product of the indigenous kingdom of Monomotapa described by the Portuguese, but that its builders culturally resembled the Baganda, and probably certain other of the more advanced peoples of Central Africa.

For bibliography, *see* the references in the text. (C. G. S.)

## NORTH AFRICA

The archaeological documents of north Africa reflect the cultural conditions recorded in its ancient history, the imposition of successive alien civilizations by dominant Mediterranean Powers upon a receptive but resistant native population. The ancient invaders were (under their political names) Phoenicians, Greeks, Romans, Vandals and Byzantines; the Arab invasions, which began in the 7th century A D, belong to modern history.

**Native Cultures.**—The native Libyan and Berber (*q.v.*) elements, whether aboriginal or not, have persisted without visible change from the prehistoric period to the present day Their most ancient handiwork is represented by stone implements and simple pottery found in cave-dwellings, figures of men and animals engraved on rocks, some fortress-walls and many sepulchral monuments of megalithic type, square and circular dolmens, cairns and cromlechs. This material is related on the one side to the most primitive remains of Spain and south France, on the other side to those of Egypt and Crete; but while neolithic culture in the Egyptian and European areas was superseded in the prehistoric age, the African stone implements seem to have remained in use in certain districts until very recent times. It is seldom possible to date these monuments even approximately The Berber language was inscribed on stone, often in conjunction with Punic and Latin texts, in a local alphabet which is still current among the Tuaregs (*q.v.*) of the Sahara Beside this backward element there was in historical times an urban population more or less civilized by contact with Greeks and Semites; but it does not appear to have developed a distinctive art Its surviving monuments are mostly sepulchral: most notable are two pyramidal structures near Tipaza (anc. *Tipasa*) and Batna in Algeria. The former, called the Tomb of the Christian Woman (*Kbor er Roumia*), is evidently a royal tomb and perhaps that of Juba II, the philhellene king of Mauretania in the time of Augustus The other, called the Medracen (*Madghasen*), is older, and may be the tomb of Massinissa, the Numidian ally of Rome in their last war with Carthage. Both are low cones of stepped masonry set on cylindrical bases which have cornices borne by engaged columns; their diameters measure about 200 feet. The form may have been derived from the native cairns, but it closely resembles the monumental tumuli of Italy and Asia. The architectural orders are Greek, with some archaisms and other peculiarities that indicate Punic influence.

**Phoenicians.**—The Phoenician settlement, of which Carthage was ultimately the chief city, is assigned to the 12th century B.C, but its earliest known remains are not older than the 7th. At the time of its fall in 146 B.C. Carthage controlled nearly the whole of what is now Tunisia, and was in touch with the native kingdom of Numidia on the west, and through the Phoenician territory of Tripolitania with the Greek colonies of Cyrenaïca on the east.

Nothing is left of the Punic city of Carthage and very little of its Roman successor, the colony which was founded as the capital of Africa after the destruction of the original Carthage. But its site is indicated by a zone of cemeteries, which lay outside the walls. It is a large semicircular area bounded on its short side by the sea; its central point, the modern St. Louis' Hill, was certainly the Punic citadel, the *Byrsa,* and the port was south of this, near the place where two lagoons now lie. These agree perhaps fortuitously with ancient descriptions of the commercial and war harbours, the latter having the Admiralty Island in its midst; but the coast has greatly changed even in the last century, and ancient lines of sea-walls and quays have been identified on the outer coast. The curse that Rome invoked upon the Punic site has operated on its own foundation. After the Arab sack, the city was abandoned by the conquerors, and became a quarry for Mediterranean masons of all later ages. The cathedral of Pisa is said to have been built with stones of Carthage. A few of the larger structures can be traced. On the Byrsa is a temple of Aesculapius; in the western plain, an amphitheatre, on either side of the northern hill, a theatre and an Odeum: in the eastern plain, the baths, better preserved in the Arab name of the locality (*Dermesh*) than in its soil. The waterworks have fared better: there are great vaulted reservoirs at Dermesh and La Malga, fed by an aqueduct from a copious source at Zaghouan, 100 miles away.

The Punic graves that have been found are not older than 700 B.C. They are mostly double chambers approached by shafts; burials were often made in stone coffins with lids carved

as recumbent human figures. There are numerous grotesque clay masks which were placed in the graves to keep evil spirits away. Personal trinkets and jewellery are the other furniture.

In a sanctuary of Baal at Dougga (*Thugga*) birds' bones were buried in jars This temple, which was dedicated to Saturn under Roman rule, was enclosed in a square colonnade. A temple of Tanit-Caelestis at the same city stands in a semicircular court. A mausoleum built there in the 4th century B.C. and recently reconstructed was designed in Graeco-Phoenician style, and bore a bilingual inscription in Libyan and Punic. The art of Carthage was rapidly hellenized, probably by contact with Greek colonies in Sicily rather than [illegible] of Africa.

**Greek.**—The largest Greek city in Africa was Cyrene, one of the greatest cities of the Greek world. Yet its famous and conspicuous site was almost inaccessible until the 20th century. In 1861 two young officers of the British forces at Malta, R Murdoch Smith and E A. Porcher, found and identified the temple of Apollo, sent to England a large series of sculptures, now in the British Museum, and excavated at other points outside and inside the city, but could not stay long enough to explore its topography more definitely. An expedition equipped by the Archaeological Institute of America made a good beginning in 1910, but met with organized hostility among the natives, and before its second season had begun the country was seized by Italy. All archaeological work in Cyrenaïca and Tripolitania has since been directed by the Italian Government. The results at Cyrene show that the Roman city occupied the two hills that are the landmarks of the site The western hill was the Greek acropolis and contained the agora; on the eastern hill is a Doric temple and a stadium; the residential quarters lay in the dividing valley and on the south-west slope of the eastern hill. At the north end of the valley, outside the city wall, the sanctuary of Apollo stands on a partly artificial platform below the fountain, Kyra. The low and narrow channel of this famous spring can be followed for a quarter of a mile inside the mountain; ancient inscriptions are scratched and moulded on the clay that covers its walls, and the mouth of the channel is an open chamber cut in the face of the cliff. Rows of chamber-tombs with elaborate architectural fronts are cut or built in the slopes of the plateau. It seems that the city when fully excavated will be another example of the conventional Roman splendour which is the characteristic element in north African antiquities; but the sanctuary is a new feature, preserving its original plan, and important remains of the Greek structures have been found beneath the Roman ornament. The sanctuary is a walled precinct like that of Delphi. It contains the temples of Apollo and Artemis, each with a great altar in front, and smaller shrines of lesser deities. A curious adjunct of the Artemisium is an underground Nymphaeum, apparently for purificatory rites. The Apollo temple has treasure-cists sunk in its floor. In Roman times two bath-establishments were intruded on the terrace, from one of which some 20 marble statues were recovered, including a headless Aphrodite now in the museum of the Terme at Rome. The rest of the material from Cyrene is at Bengazi. On the west side of the precinct is a Greek theatre. The Sacred Way leads from the sanctuary past the fountain to the agora, a colonnaded area of the usual Roman type containing the provincial *capitolium* and other official buildings. Among the Greek survivals here are the *heroön* and a small circular structure which was the tomb of the first Battos, founder of the city and of the dynasty which ruled it. The round tomb is apparently the base on which stood a column depicted on some Cyrenaïc coins. Curious sepulchral monuments found in the rock-tombs are sculptured busts with heads in which the face was indicated by painting, or with tapering columnar necks instead of heads. Greek art is rare: a few archaic votive statutes have been found and further excavation will doubtless produce others. The archaic strata should also help to determine the origin of the so-called Laconian or Cyrenaïc pottery. (*See* POTTERY AND PORCELAIN: *Greek Pottery.*) A small bronze head of a bearded man (5th century B.C.) has been found by the Italians, and a marble head of Athena (said to be 4th century) was excavated by the American expedition, but the finest work of art from Africa is a Hellenistic bronze head of a young Berber, which was found by Smith and Porcher in the temple of Apollo It is also an anthropological document of great value. There are other Hellenistic pieces among the numerous marble statues from Cyrene, but the sculpture here as in other north African cities is generally of Roman date. The other cities of Cyrenaica have produced Greek terra-cotta statuettes and painted vases, mostly from tombs; among the vases are several oil-jars which were prizes in the Panathenaic games. The Punic colonies must have contained examples of Greek art, and the Mauretanian capital of Juba II. at Cherchel (*Caesarea*) was decorated with imported statuary, some fragments of which survive. Some good examples of Hellenistic sculpture have come from the sea They were found in a sunken ship which was located in 1907 off Mahedia near the Lesser Syrtes, and are now in the museum of the Bardo at Tunis. The most important is a bronze herm signed by Boëthos of Chalchedon. There are many decorative bronzes belonging to furniture, and parts of large marble vases and candelabra in Neo-Attic style. The ship's hold was divided into three compartments, and the deck was laden with marble columns. The date of the wreck is placed in the 2nd century B.C. Two large bronze statuettes, a standing boy and a seated girl, came from the harbour of Bône (*Hippo Regius*) in 1912, and a bronze horseman, said to be of the 5th century B.C., was excavated at Ksar Farun (*Volubilis*) in Morocco.

**Roman.**—Most of the Roman cities are comparatively late foundations. The civilization of Africa was never finished, and its imperial history is a record of continual progress southwards and westwards from the original province to the Sahara and the ocean. Even the older Greek and Carthaginian cities, such as Cyrene and Thugga, and the native capitals of Cirta and Caesarea, were converted to the metropolitan Roman model in the mature imperial age. But the ordinary African township was a mushroom growth, built to an emperor's order and peopled with colonists from the army and the countryside. As the citizens were Romanized by the gift of the Latin name, so the dignity of their city was asserted in its public buildings. Theatres and baths were erected and adorned by the munificence of wealthy Africans, to whom and to Roman landowners and their agents belonged the luxurious villas that are scattered through the country districts. But the urban population in general was meanly housed. The best example of a new city is Timgad (*Thamugadi*) in south-east Algeria (*Numidia*), north of Mt. Aures. It was founded by Trajan as a colony in A.D. 100, and built by military architects and labour from the Legion III. Augusta, whose discharged soldiers were the colonists. The site is laid out on the lines of a military camp, a square cut up into small blocks (*insulae*) by intersecting streets drawn parallel to the enclosing ramparts. A monumental gateway (the so-called triumphal arch of Trajan) stands in the middle of the west side. At the central crossing of the two main streets (*cardo* and *decumanus*) is the *forum,* occupying the space of eight *insulae,* and next to the forum is a theatre. Other public buildings now inside the ramparts are a market-place, a library and baths. The city rapidly outgrew its walls; the later *capitolium,* more baths, a larger market, another triumphal arch, pagan temples and Christian churches were built outside, and as the town grew its formal character was lost. The camp in which the legion itself was permanently quartered is *Lambaesis,* 20m. W. of Timgad. It was established in the first half of the 2nd century, and consists of a fortified square intersected by the two main roads and containing military offices, barracks and baths. A great part of the site is covered by a modern prison. To the south lies the town that attached itself to the legion, entered through monumental arches and equipped with the usual apparatus of capitol and lesser temples, theatres, amphitheatre and baths. Lembaesis is a unique example of a permanent camp. *Cardo* and *decumanus* are paved with stone and bordered with colonnades, and south of their intersection stands nearly to its full height the four-arched entrance to the *praetorium,* leading to a court with porticoes behind which are the headquarters' offices, legionary shrines and armouries.

Other municipal foundations were built on the same model as Timgad, but not always with the formal plan that can only be

achieved on an empty site. The best preserved structures are probably those of Lebda (*Leptis Magna*) in Tripolitania. This was the native city of the emperor Severus, and was magnificently adorned by him. It has been covered by wind-borne sand, which overthrew whole walls with its weight and at the same time buried and protected their ruins. But many walls and columns are still standing with cornices and entablatures intact. At the other end of the Roman dominion, in Morocco, lies Ksar Farun (*Volubilis*) near Meknes, a solitary outpost of classical culture in a barbarous land. A triumphal arch and the remains of a basilica were visible before its excavation. The site was largely cleared by prisoners of war in 1915. Other well-preserved or excavated cities are, in Algeria, Jemila (*Cuicul*), Khamissa (*Thubursicum Numidorum*), and Tipaza (*Tipasa*); in Tunisia, Bou Grara (*Ghighti*), Dougga (*Thugga*), Henchir Kasbat (*Thuburbo Maius*), Medeina (*Althiburus*), and Sbeïtla (*Sufetula*); and Sabratha in Tripolitania. In all of these the usual public places are represented, the *forum* with its *curia, basilica,* and *rostra,* flanked by temples and porticoes which sheltered honorific statues. Khamissa has its table of standard measures still in place; Timgad, Lembaesis, Jemila and Henchir Kasbat have markets appropriately fitted for various commodities. In the military foundations these lie just outside the gates, but Timgad has also smaller and perhaps later markets within the ramparts. There is also a library at Timgad, unique in Africa. Baths and triumphal arches (gateways) abound on these and many other sites, and each city has its theatre; those of Cherchel and Dougga are particularly well preserved. The finest amphitheatre is at El Jem (*Thysdrus*). The official sacred building of a provincial town was the *capitolium,* and was usually placed near the *forum,* but at Timgad it lies outside the walls. The regular tripartite plan is seen in this example. At Dougga the front columns with their pediment are still standing, and at Sbeïtla the capitol consists of three separate shrines. A temple at Tebessa (*Theveste*) is nearly intact, and has an elaborately carved parapet but no pediment. A notable temple is that of Aesculapius at Lembaesis, which has a thermal establishment attached and is approached through an avenue of subsidiary chapels. Many miles of aqueducts are standing between the cities and the springs from which they drew their water. The supply of Carthage came from Zaghouan, where there is an elaborate *Nymphaeum.* Similar water-sanctuaries exist at Hammam Derraji (*Bulla Regia*), Khamissa and elsewhere; the aqueduct at Sbeïtla is carried over the ravine on a massive bridge. Houses of Graeco-Roman design like those of Pompeii have been excavated on many sites: most famous is the House of Sertius at Timgad, but this does not belong to the original city. Bulla Regia has some underground houses, and there are catacombs at Sousse (*Hadrumetum*).

Large quantities of Roman sculpture have been found in these excavations, and are housed in the local museums, among them many imperial portraits and other pieces of historical value. Inscriptions also are abundant. But the peculiar artistic riches of north Africa are mosaic pavements, which have for their subjects, besides decorative patterns, seascapes and landscapes, historical and mythological scenes and incidents of agricultural life, fishing, hunting and games. Among them are portraits of Xenophon from Sbeïtla and Virgil from Sousse. A large and varied series comes from a villa near Zliten in Tripolitania.

**Vandal and Byzantine.**—Mosaic decoration is a prominent feature in the remains of Early Christian churches (basilicas): there are particularly fine examples in the baptisteries of Jemila, Sbeïtla and Timgad. At the last place the church is attached to a monastery, as also at Tebessa. Some of the churches are Late Roman, others are Byzantine foundations. During the short interval of Vandal occupation (AD 439–533) there seems to have been no architectural activity, but some fortification and a good deal of military demolition date from this epoch. Examples of the latter are supplied by the theatres of Carthage, which were filled in with the ruins of their superstructures The great fortress walls that dominate many sites are Byzantine. They were erected to hold the civilized country against native tribes, the same aggressors that the Roman conquerors had to face; and it is significant that the two most imposing Byzantine strongholds, at Haïdra and Tebessa, are on the sites of the first permanent camps that the Roman legion fortified on Mt. Aures (*Ammaedara* and *Theveste*). Haïdra is the type of a military fort, Tebessa of a fortified city. The fortress-walls were made of ancient materials, and often incorporate whole buildings of preceding ages Triumphal arches at Tebessa are worked into the circuit of the ramparts; one at Haïdra was built up to make a tower; the capitols of Dougga and Sbeïtla were turned into forts. The ruin of classical buildings involved in these defensive works was immense, and it has been justly said that the real vandals of north Africa were the Byzantines. Arab conquests, though fatal to town-dwellers, did no great damage to the structures. Indeed their subsequent desertion and neglect have been the means of preserving so many Roman cities to an extent unequalled in any other land. (E. J. F.)

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## HISTORY

The ancient history of Africa is shrouded in mystery and the earliest records of that continent and its people are far from trustworthy. *See* AFRICA, ROMAN; EGYPT.

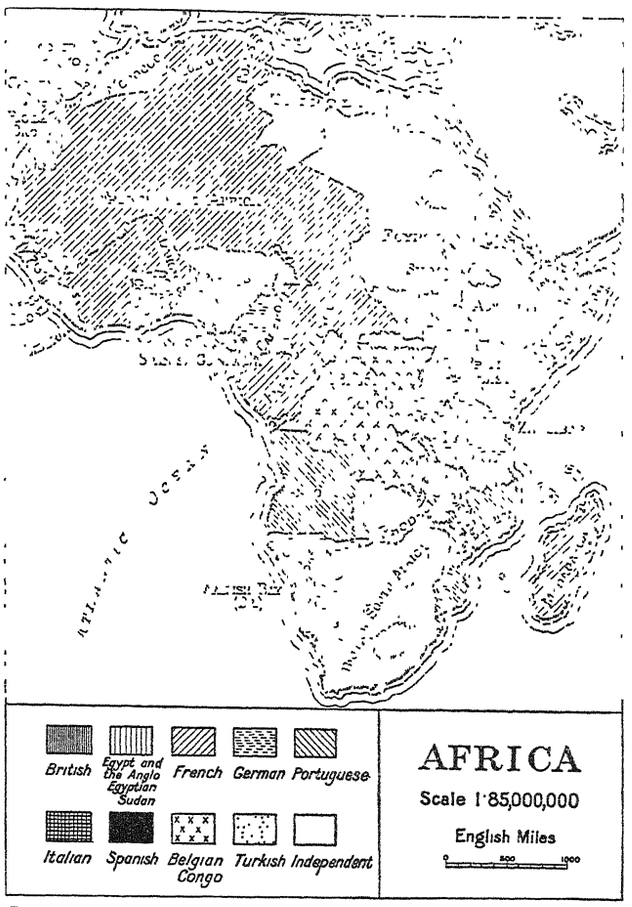
**Phoenician and Greek Colonization.**—The word Africa was applied originally to the country in the immediate neighbourhood of Carthage, that part of the continent first known to the Romans, and it was subsequently extended with their increasing knowledge. The Arabs still confine the name Ifrikia to the territory of Tunisia. If ancient Egypt and Ethiopia (*q.v.*) be excluded, the story of Africa is largely a record of the doings of its Asiatic and European conquerors and colonizers, Abyssinia being the only State which throughout historic times has maintained its independence. The countries bordering the Mediterranean were first exploited by the Phoenicians. Carthage, founded about 800 B.C., speedily grew into a city without rival in the Mediterranean, and the Phoenicians, subduing the Berber tribes, who then, as now, formed the bulk of the population, became masters of all the habitable region of north Africa west of the Great Syrtis. Both Egyptians and Carthaginians made attempts to reach the unknown parts of the continent by sea. The west coast was well known to the Phoenicians as far as Cape Nun, and *c.* 520 B.C. Hanno, a Carthaginian, explored the coast at least as far as Sierra Leone.



A WOMAN OF ZULULAND

Meantime the first European colonists had settled in Africa. Greeks founded the city of Cyrene (*c.* 631 B.C.) and exerted a powerful influence in Egypt. To Alexander the Great the city of Alexandria owes its foundation (332 B.C.), and under the Hellenistic dynasty of the Ptolemies attempts were made to penetrate southward, and in this way was obtained some knowledge of Abyssinia. Neither Cyrenaica nor Egypt was a serious rival to the Carthaginians, but all three Powers were eventually supplanted by the Romans after the fall of Carthage in 146 B.C. Under Rome the settled portions of the country were very prosperous, and a Latin strain was introduced into the land. Though Fezzan was occupied by them, the Romans elsewhere found the Sahara an impassable barrier. The utmost extent of geographical knowledge of the continent is shown in the writings of Ptolemy (2nd century A.D.), who guessed the existence of the great lake reservoirs of the Nile and had heard of the river Niger. (For the history of Africa under the empire, *see* ROMAN EMPIRE, LATER.)

**The Arab Conquest.**—In the 7th century an Arab host, following the new faith of Mohammed, conquered the whole country from the Red sea to the Atlantic and entered Spain. Throughout north Africa Christianity well-nigh disappeared, save in Egypt (where the Coptic Church was suffered to exist), and Upper Nubia and Abyssinia, which were not subdued In the 8th, 9th and 10th centuries the Arabs in Africa were numerically weak; but in the




POLITICAL DIVISIONS OF AFRICA IN 1910 AT THE CLOSE OF THE FINAL PHASE OF THE INTERNATIONAL "SCRAMBLE FOR TERRITORY"
Two further adjustments took place before the World War. By the 1911 agreement the Cameroon received two tongue-like extensions—one reaching to the Congo river, the other to the Ubangi. On Nov. 5, 1911, as the result of a brief war with Turkey, Italian sovereignty was extended over Tripoli

11th century there was a great Arab immigration. Even before this the Berbers had very generally adopted the speech and religion of their conquerors. Arab influence and the Mohammedan religion thus became indelibly stamped on northern Africa. Together they spread southward across the Sahara, and became firmly established along the eastern sea-board, where Arabs, Persians and Indians planted flourishing maritime and commercial colonies. Of these eastern cities and States both Europe and the Arabs of north Africa were long ignorant.

The first Arab invaders had recognized the authority of the caliphs of Baghdad. Early in the 10th century the Fatimite dynasty established itself in Egypt, where Cairo had been founded A.D. 968, and from there ruled as far west as the Atlantic. Later still arose other dynasties such as the Almoravides and Almohades. Eventually the Turks, who had seized Egypt in 1517, established the regencies of Algeria, Tunisia and Tripoli (between 1519 and 1551), Morocco remaining an independent Arabized Berber State under the Sharifan dynasty, which had its beginnings at the end of the 13th century. Under the earlier dynasties the spirit of adventure and the proselytizing zeal of the followers of Islam led to a considerable extension of the knowledge of the continent. This was rendered more easy by their use of the camel, which enabled the Arabs to traverse the desert. In this way Senegambia and the middle Niger regions fell under the influence of the Arabs and Berbers, but it was not until 1591 that Timbuktu—founded in the 11th century—became Muslim. That city had been reached in 1352 by the great Arab traveller Ibn Batuta, to whose journey to Mombasa and Quiloa (Kilwa) was due the first accurate knowledge of those flourishing Muslim cities on the east African sea-board. Except along this sea-board, which was colonized directly from Asia, Arab progress southward was stopped by the broad belt of dense forest which, stretching almost across the continent somewhat south of 10° N., barred their advance as effectually as had the Sahara that of their predecessors, and cut them off from knowledge of the Guinea coast and of all Africa beyond. One of the regions which came latest under Arab control was Nubia, where a Christian civilization and State existed up to the 14th century

For a time the Muslim conquests in south Europe had virtually made of the Mediterranean an Arab lake, but in the 11th century the Norman conquest of Sicily was followed by their descent on Tunisia and Tripoli Somewhat later a busy trade with the African coast-lands, especially Egypt, was developed by the cities of north Italy. The Italians also, in the 14th and 15th centuries, traded with the countries of the Niger bend and were conversant with the routes across the Sahara Some Europeans even traversed the desert, while one traveller—not a merchant—the Frenchman Anselme d'Isalguier reached Gao on the Niger, in 1405.[1] Meanwhile events were impending which were to have a profound effect on north-west Africa. By the end of the 15th century Spain had completely thrown off the Muslim yoke, but even while the Moors were still in Granada, Portugal was strong enough to carry the war into Africa. In 1415 a Portuguese force captured the citadel of Ceuta on the Moorish coast. From that time Portugal repeatedly interfered in the affairs of Morocco, while Spain acquired many ports in Algeria and Tunisia. Portugal, however, suffered a crushing defeat in 1578 at al Kasr al Kebir, the Moors being led by Abd el Malek I. of the Sherifan dynasty. By that time the Spaniards had lost almost all their African possessions. The Barbary States degenerated into mere communities of pirates, and under Turkish influence civilization and commerce declined. (X.)

## MODERN HISTORY

**The Portuguese.**—But with the battle of Ceuta, Africa had ceased to belong solely to the Mediterranean world. Among those who fought there was Prince Henry "the Navigator," son of King John I., who was fired with the ambition to acquire for Portugal the unknown parts of Africa. Under his inspiration and direction was begun that series of voyages of exploration which resulted in the circumnavigation of Africa and the establishment of Portuguese sovereignty over large areas of the coast-lands. Cape Bojador was doubled in 1434, Cape Verde in 1445, and by 1480 the whole Guinea coast was known. In 1482 Diogo Cam or Cão discovered the mouth of the Congo; the Cape of Good Hope was doubled by Bartholomew Diaz in 1488, and in 1498 Vasco da Gama, after having rounded the Cape, sailed up the east coast, touched at Sofala and Malindi, and went thence to India. Over all the countries discovered by their navigators Portugal claimed sovereign rights, but these were not exercised in the extreme south of the continent. The Guinea coast, as the first discovered and the nearest to Europe, was first exploited. Numerous forts and trading stations were established, the earliest being São Jorge da Mina (Elmina), begun in 1482. The chief commodities dealt in were slaves, gold, ivory and spices. The discovery of America (1492) was followed by a great development of the slave trade, which, before the Portuguese era, had been an overland trade almost exclusively confined to Mohammedan Africa. The lucrative nature of this trade, and the large quantities of alluvial gold obtained by the Portuguese, drew other nations to the Guinea coast English mariners went thither as early as 1553, and they were followed by Spaniards, Dutch, French, Danish, and

[1] D'Isalguier afterwards wrote an account (never published) of his travels, which were made known in 1927 by Charles de la Roncière in vol. iii. of *La Découverte de l'Afrique au Moyen Âge.*

other adventurers. Much of Senegambia was made known as a result of quests during the 16th century for the "hills of gold" in Bambuk and the fabled wealth of Timbuktu, but the middle Niger was not reached. The supremacy along the coast passed in the 17th century from Portugal to Holland and from Holland in the 18th and 19th centuries to France and England. The whole coast from Senegal to Lagos was dotted with forts and "factories" of rival Powers, and this international patchwork persists though all the *hinterland* has become either French or British territory.

Southward from the mouth of the Congo[1] to the inhospitable region of Damaraland, the Portuguese, from 1491 onward, acquired influence over the Bantu-Negro inhabitants, and in the early part of the 16th century through their efforts Christianity was largely adopted in the native kingdom of Congo. An irruption of cannibals from the interior later in the same century broke the power of this semi-Christian state, and the Portuguese activity was transferred to a great extent farther south, São Paulo de Loanda being founded in 1576. The sovereignty of Portugal over this coast region, except for the mouth of the Congo, has been only once challenged by a European Power, and that was in 1640–48, when the Dutch held the seaports.

Neglecting the comparatively poor and thinly inhabitated regions of South Africa, the Portuguese no sooner discovered than they coveted the flourishing cities held by Arabized peoples between Sofala and Cape Guardafui. By 1520 all these Muslim sultanates had been seized by Portugal, Mozambique being chosen as the chief city of her East African possessions. Nor was Portuguese activity confined to the coast-lands. The lower and middle Zambezi valley was explored (16th and 17th centuries), and here the Portuguese found semi-civilized Bantu-Negro tribes, who had been for many years in contact with the coast Arabs. Strenuous efforts were made to obtain possession of the country (modern Rhodesia) known to them as the kingdom or empire of Monomotapa, where gold had been worked by the natives from about the 12th century A.D., and whence the Arabs, whom the Portuguese dispossessed, were still obtaining supplies in the 16th century. Several expeditions were despatched inland from 1569 onward and considerable quantities of gold were obtained. Portugal's hold on the interior, never very effective, weakened during the 17th century, and in the middle of the 18th century ceased with the abandonment of the forts in the Manica district.

At the period of her greatest power Portugal exercised a strong influence in Abyssinia also. In the ruler of Abyssinia (to whose dominions a Portuguese traveller had penetrated before Vasco da Gama's memorable voyage) the Portuguese imagined they had found the legendary Christian king, Prester John, and when the complete overthrow of the native dynasty and the Christian religion was imminent by the victories of Mohammedan invaders, the exploits of a band of 400 Portuguese under Christopher da Gama during 1541–43 turned the scale in favour of Abyssinia and had thus an enduring result on the future of north-east Africa. After da Gama's time Portuguese Jesuits resorted to Abyssinia. While they failed in their efforts to convert the Abyssinians to Roman Catholicism they acquired an extensive knowledge of the country. Pedro Paez in 1615, and, ten years later, Jeronimo Lobo, both visited the sources of the Blue Nile. In 1663 the Portuguese, who had outstayed their welcome, were expelled from the Abyssinian dominions. At this time Portuguese influence on the Zanzibar coast was waning before the power of the Arabs of Muscat, and by 1730 no point on the east coast north of Cape Delgado was held by Portugal.

**The English and the Dutch.**—It has been seen that Portugal took no steps to acquire the southern part of the continent. To the Portuguese the Cape of Good Hope was simply a landmark on the road to India, and mariners of other nations who followed in their wake used Table Bay only as a convenient spot wherein to refit on their voyage to the East. By the beginning of the 17th century the bay was much resorted to for this purpose, chiefly by English and Dutch vessels. In 1620, with the object of forestalling the Dutch, two officers of the East India Company, on their own initiative, took possession of Table Bay in the name of King James, fearing otherwise that English ships would be "frustrated of watering but by licence." Their action was not approved in London, and the proclamation they issued remained without effect. The Netherlands profited by the apathy of the English. On the advice of sailors who had been shipwrecked in Table Bay the Netherlands East India Company, in 1651, sent out a fleet of three small vessels under Jan van Riebeek which reached Table Bay on April 6, 1652, when, 164 years after its discovery, the first permanent white settlement was made in South Africa. The Portuguese, whose power in Africa was already waning, were not in a position to interfere with the Dutch plans, and England was content to seize the island of St. Helena as her half-way house to the East.[1] In its inception the settlement at the Cape was not intended to become an African colony, but was regarded as the most westerly outpost of the Dutch East Indies. Nevertheless, despite the paucity of ports and the absence of navigable rivers, the Dutch colonists, freed from any apprehension of European trouble by the friendship between Great Britain and Holland and leavened by Huguenot blood, gradually spread eastward.

[1]This river was called by the Portuguese the Zaire. They appear to have made no attempt to trace its course beyond the rapids which stop navigation from the sea.

### MODERN EXPLORATION

During the 18th century there is little to record in the history of Africa. The nations of Europe, engaged in the later half of the century in almost constant warfare and struggling for supremacy in America and the East, to a large extent lost their interest in the continent. Only on the west coast was there keen rivalry, and here the motive was the securance of trade rather than territorial acquisitions. In this century the slave trade reached its highest development, the trade in gold, ivory, gum, and spices being small in comparison. In the interior of the continent—Portugal's energy being expended—no interest was shown, the nations with establishments on the coast "taking no further notice of the inhabitants or their land than to obtain at the easiest rate what they procure with as little trouble as possible, or to carry them off for slaves to their plantations in America" (*Encyclopædia Britannica*, 3rd. ed. 1797). Even the scanty knowledge acquired by the ancients and the Arabs was in the main forgotten or disbelieved. It was the period when—

> Geographers, in Afric maps,
> With savage pictures filled their gaps,
> And o'er inhabitable downs
> Placed elephants for want of towns.
>
> (*Poetry, a Rhapsody*. By Jonathan Swift.)

The prevailing ignorance may be gauged by the statement in the third edition of the *Encyclopædia Britannica* that "the Gambia and Senegal rivers are only branches of the Niger." But the closing years of the 18th century, which witnessed the partial awakening of the public conscience of Europe to the iniquities of the slave trade, were also notable for the revival of interest in inner Africa. A society, the African Association,[2] was formed in London in 1788 for the exploration of the interior of the continent. The era of great discoveries had begun a little earlier in the famous journey (1770–72) of James Bruce through Abyssinia and Sennar, during which he determined the course of the Blue Nile. But it was through the agents of the African Association that knowledge was gained of the Niger regions. The Niger was reached by Mungo Park, who travelled by way of the Gambia, in 1795. Park, on a second journey in 1805, passed Timbuktu and descended the Niger to Bussa, where he lost his life, having just failed to solve the question as to where the river reached the ocean. (This problem was ultimately solved by Richard Lander and his brother in 1830.) The first scientific explorer of South-East Africa, Dr. Francisco de Lacerda, a Portu-

[1]France acquired, as stations for her ships on the voyage to and from India, settlements in Madagascar and the neighbouring islands. The first settlement was made in 1642.

[2]The Association, in 1831, was merged in the Royal Geographical Society.

guese, also lost his life in that country. Lacerda travelled up the Zambezi to Tete, going thence towards Lake Mweru, near which he died in 1798. The first recorded crossing of Africa was accomplished between the years 1802 and 1811 by two half-caste Portuguese traders, Pedro Baptista and A. José, who passed from Angola eastward to the Zambezi.

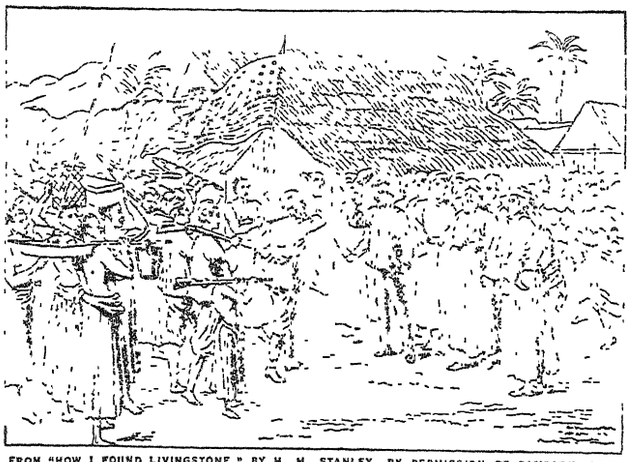
Although the Napoleonic wars distracted the attention of Europe from exploratory work in Africa, those wars nevertheless exercised great influence on the future of the continent, in both Egypt and South Africa. The occupation of Egypt (1798–1803) first by France and then by Great Britain, resulted in an effort by Turkey to regain direct control over that country,[1] followed in 1811 by the establishment, under Mohammed Ali, of an almost independent state, and the extension of Egyptian rule over the eastern Sudan (from 1820 onward). In South Africa the struggle with Napoleon caused Great Britain to take possession of the Dutch settlements at the Cape, and in 1814 Cape Colony, which had been continuously occupied by British troops since 1806, was formally ceded to the British crown.

The close of the European conflicts with the battle of Waterloo was followed by vigorous efforts on the part of the British Government to become better acquainted with Africa, and to substitute colonization and legitimate trade for the slave traffic, declared illegal for British subjects in 1807 and abolished by all other European Powers by 1836. To West Africa Britain devoted much attention. The slave trade abolitionists had already, in 1788, formed a settlement at Sierra Leone, on the Guinea coast, for freed slaves, and from this establishment grew the colony of Sierra Leone,[2] long notorious, by reason of its deadly climate, as "The White Man's Grave." Farther east the establishments on the Gold Coast began to take a part in the politics of the interior, and the first British mission to Kumasi, despatched in 1817, led to the assumption of a protectorate over the maritime tribes heretofore governed by the Ashanti.

An expedition sent in 1816 to explore the Congo from its mouth did not succeed in getting beyond the rapids which bar the way to the interior, but in the central Sudan much better results were obtained. In 1823 three English travellers, Walter Oudney, Dixon Denham, and Hugh Clapperton, reached Lake Chad from Tripoli—the first white men to reach that lake. The partial exploration of Bornu and the Hausa states by Clapperton, which followed, revealed the existence of large and flourishing cities and a semi-civilized people in a region hitherto unknown. The discovery in 1830 of the mouth of the Niger by Clapperton's servant, Lander, already mentioned, had been preceded by the journeys of Maj. A. G. Laing (1826) and René Caillié (1827) to Timbuktu, and was followed (1832–33) by the partial ascent of the Benue affluent of the Niger by MacGregor Laird. In 1841 a disastrous attempt was made to plant a white colony on the lower Niger, an expedition (largely philanthropic and anti-slavery in its inception) which ended in utter failure. Nevertheless, from that time British traders remained on the lower Niger, their continued presence leading ultimately to the acquisition of political rights over the delta and the Hausa states by Great Britain.[3] Another endeavour by the British Government to open up commercial relations with the Niger countries resulted in the addition of a vast amount of information concerning the countries between Timbuktu and Lake Chad, owing to the labours of Heinrich Barth (1850–55), originally a subordinate, but the only surviving member of the expedition sent out.

Meantime considerable changes had been made in other parts of the continent, the most notable being the occupation of Algiers by France in 1830, an end being thereby put to the piratical proceedings of the Barbary States; the continued expansion southward of Egyptian authority, with the consequent additions to the knowledge of the Nile; and the establishment of independent states (Orange Free State and the Transvaal) by Dutch farmers (Boers) dissatisfied with British rule in Cape Colony Natal, so named by Vasco da Gama, had been made a British colony (1843), the attempt of the Boers to acquire it being frustrated. The city of Zanzibar, on the island of that name, founded in 1832 by Seyyid Said of Muscat, rapidly attained importance, and Arabs began to penetrate to the great lakes of East Africa,[1] concerning which little more was known (and less believed) than in the time of Ptolemy. Accounts of a vast inland sea, and the discovery in 1848–49, by the missionaries Ludwig Krapf and J Rebmann, of the snow-clad mountains of Kilimanjaro and Kenya, stimulated in Europe the desire for further knowledge.

**Livingstone and Stanley.**—At this period, the middle of the 19th century, Protestant missions were carrying on active propaganda on the Guinea coast, in South Africa, and in the Zanzibar dominions. Their work, largely beneficent, was being conducted in regions and among peoples little known, and in many instances missionaries turned explorers and became pioneers of trade and empire. One of the first to attempt to fill up the remaining blank spaces in the map was David Livingstone, who had been engaged since 1840 in missionary work north of the Orange In 1849 Livingstone crossed the Kalahari desert from south to north and reached Lake Ngami, and between 1851 and 1856 he traversed the continent from west to east, making known the great waterways of the upper Zambezi During these journeyings Livingstone discovered, Nov. 1855, the famous Victoria Falls, so named after the queen of Great Britain. In 1858–64 the lower Zambezi, Shiré, and Lake Nyasa were explored by Livingstone, Nyasa having been first reached by the confidential slave of Antonio da Silva Porto, a Portuguese trader established at Bihé in Angola, who crossed Africa during 1853–56 from Benguella to the mouth of the Rovuma While Livingstone circumnavigated Nyasa, the more northerly lake, Tanganyika, had been visited (1858) by Richard Burton and J H Speke, and the last named had sighted Victoria Nyanza Returning to East Africa with J. A. Grant, Speke reached, in 1862, the river which flowed from Victoria



FROM "HOW I FOUND LIVINGSTONE," BY H. M. STANLEY, BY PERMISSION OF SAMPSON, LOW, MARSTON & CO., LTD., AND OF CHARLES SCRIBNER S SONS

**STANLEY GREETS LIVINGSTONE WITH "DR. LIVINGSTONE, I PRESUME" After a hazardous journey of 295 days Stanley, on Nov. 10, 1871, reached Ujiji, where he found Dr. Livingstone, sick, emaciated and depressed**

Nyanza and, following it (in the main) down to Egypt, had the distinction of being the first man to read the riddle of the Nile. In 1864 another Nile explorer, Samuel Baker, discovered the Albert Nyanza, the chief western reservoir of the river. In 1866 Livingstone began his last great journey, in which he made known Lakes Mweru and Bangweulu and discovered the Lualaba (the upper part of the Congo), but died (1873) before he had been able to demonstrate its ultimate course, believing indeed that the Lualaba belonged to the Nile system. Livingstone's lonely death in the heart of Africa evoked a keener desire than ever to complete the work he left undone. H. M. Stanley, who had in 1871

[1]The Mamelukes, whom the Turks had overthrown in the 16th century, had regained practically independent power.

[2]In imitation of the British example, an American society founded in 1822 the negro colony (now republic) of Liberia.

[3]The first territorial acquisition made by Great Britain in this region was in 1851, when Lagos Island was annexed.

[1]As early as 1848 an Arab from Zanzibar journeying across the continent had arrived at Benguella.

succeeded in finding and succouring Livingstone, started again for Zanzibar in 1874, and in the most memorable of all exploring expeditions in Africa circumnavigated Victoria Nyanza and Tanganyika, and, striking farther inland to the Lualaba, followed that river down to the Atlantic ocean—reached in Aug. 1877—and proved it to be the Congo. In South Africa, Karl Mauch in 1871 discovered the ruins of the great Zimbabwe in Mashonaland, and in the following year F. C. Selous began his journeys over South Central Africa.

Explorers were active also in other parts of the continent. Southern Morocco, the Sahara, and the Sudan were traversed in many directions between 1860 and 1875 by Gerhard Rohlfs, Georg Schweinfurth and Gustav Nachtigal. These travellers not only added considerably to geographical knowledge, but obtained invaluable information concerning the people, languages, and natural history of the countries in which they sojourned [1] Among the discoveries of Schweinfurth was one that confirmed the Greek legends of the existence beyond Egypt of a pygmy race. But the first discoverer of the dwarf races of Central Africa was Paul du Chaillu, who found them in the Ogowé district of the west coast in 1865, five years before Schweinfurth's first meeting with the pygmies; du Chaillu having previously, as the result of journeys in the Gabun country between 1855 and 1859, made popular in Europe the knowledge of the existence of the gorilla, perhaps the gigantic ape seen by Hanno the Carthaginian, and whose existence, up to the middle of the 19th century, was thought to be as legendary as that of the pygmies of Aristotle.

Stanley's great journey down the Congo in 1875–76 initiated a new era in African exploration, and since 1875 the map has been filled with authentic topographical details. Within their respective spheres of influence each Power undertook detailed surveys, and the most solid of the latest accessions to knowledge have resulted from the labours of hard-working colonial officials toiling individually in obscurity.

In 1877 an important expedition was sent out by the Portuguese Government under Serpa Pinto, Brito Capello, and Roberto Ivens for the exploration of the interior of Angola. The first named made his way by the head-streams of the Kubango to the upper Zambezi, which he descended to the Victoria Falls, proceeding thence to Pretoria and Durban. Capello and Ivens confined their attention to the south-west Congo basin, where they disproved the existence of Lake Aquilunda, which had figured on the maps of that region since the 16th century. In a later journey (1884–85) Capello and Ivens crossed the continent from Mossamedes to the mouth of the Zambezi adding considerably to the knowledge of the borderlands between the upper Congo and the upper Zambezi. More important results were obtained by the German travellers, Paul Pogge and Hermann von Wissmann, who (1880–82) passed through previously unknown regions beyond Muata Yanvo's kingdom, and reached the upper Congo at Nyangwe, whence Wissmann made his way to the east coast. In 1884–85 a German expedition under Wissmann solved the most important geographical problem relating to the southern Congo basin by descending the Kasai, the largest southern tributary, which contrary to expectation proved to unite with the Kwango and other streams before joining the main river. Further additions to the knowledge of the Congo tributaries were made at the same time by the Rev. George Grenfell, a Baptist missionary, who (accompanied in 1885 by K. von François) made several voyages in the steamer "Peace," especially up the great Ubangi, ultimately proved to be the lower course of the Welle, discovered in 1870 by Schweinfurth.

**East Africa.**—The first new journey of importance in East Africa was made (1878–80) on behalf of the British African Exploration committee by Joseph Thomson, who after the death of his leader, Keith Johnston, made his way from the coast to the north end of Nyasa, thence to Tanganyika, on both sides of which he broke new ground, sighting the north end of Lake Rukwa on the east In 1882–84 the French naval lieutenant, Victor Giraud, proceeded by the north of Nyasa to Lake Bangweulu, of which he made the first fairly correct map. North of the Zanzibar-Tanganyika route a large area of new ground was opened in 1883–84 by Thomson, who traversed the whole length of the Masai country to Lake Baringo and Victoria Nyanza, shedding the first clear light on the great East African rift-valley and neighbouring highlands, including Mts. Kenya and Elgon. A great advance in the region between Victoria Nyanza and Abyssinia was made in 1887–89 by the Austrians, Count Samuel Teleki and Lieut. Ludwig von Höhnel, who discovered the large Basso Norok, now known as Lake Rudolf, till then only vaguely indicated on the map as Samburu At this time Somaliland was being opened up by English and Italian travellers. In 1883 the brothers F. L. and W. D. James penetrated from Berbera to the Webi Shebeli; in 1892 Vittorio Bottego (afterwards murdered in the Abyssinian highlands) started from Berbera and reached the upper Juba, which he explored to its source. The first person to cross from the Gulf of Aden to the Indian Ocean was an American, A. Donaldson Smith, who in 1894–95 explored the head-streams of the Webi Shebeli and also explored the Omo, the feeder of Lake Rudolf.

In the region north-west of Victoria Nyanza the greatest additions to geographical knowledge were made by H. M. Stanley in his last expedition, undertaken for the relief of Emin Pasha. The expedition set out in 1887 by way of the Congo and made its way, encountering immense difficulties, through the great equatorial forest, the character and extent of which were thus for the first time brought to light. The return was made to the east coast and resulted in the discovery of the great snowy range of Ruwenzori or Runsoro, and the confirmation of the existence of a third Nile lake discharging its waters into the Albert Nyanza by the Semliki river.

**North and West Africa.**—Great activity was also displayed in completing the work of earlier explorers in North and West Africa. Morocco was in 1883–84 the scene of important explorations by de Foucauld, a Frenchman who, disguised as a Jew, crossed and re-crossed the Atlas and supplied the first trustworthy information as to the orography of many parts of the chain. In 1887–89 Louis Gustave Binger, a French officer, made a great journey through the countries enclosed in the Niger bend, and in 1890–92 Col. P. F. Monteil went from St. Louis to Say, on the Niger, thence through Sokoto to Bornu and Lake Chad, whence he crossed the Sahara to Tripoli. Meantime explorers had been busy in the region between Lake Chad, the Gulf of Guinea, and the Congo. The Sanga, one of the principal northern tributaries of the Congo, was reached from the north by Lieut. Louis Mizon, a French naval officer, who drew the first line of communication between the Benue and the Congo (1890–92). In 1890 Paul Crampel, who in the previous year had explored north of the Ogowé, undertook a great expedition from the Ubangi to the Shari, but was attacked and killed, with several of his companions, on the borders of the Bagirmi. Several other expeditions followed, and in 1896 Emile Gentil reached the Shari, launched a steamer on its waters and pushed on to Lake Chad. Early in 1900 Lake Chad was also reached by F. Foureau, a French traveller, who had already devoted 12 years to the exploration of the Sahara, and who on this occasion had crossed the desert from Algeria and had reached the lake *via* Air and Zinder.

**Equatorial Africa.**—The last ten years of the 19th century also witnessed many interesting expeditions in east Central Africa. In 1891 Emin Pasha, accompanied by Dr. F. Stuhlmann, made his way south of Victoria Nyanza to the western Nile lakes, visiting for the first time the southern and western shores of Albert Edward. Stuhlmann also ascended the Ruwenzori range to a height of over 13,000 feet. In the same year Dr. O. Baumann, who had already done good work in Usambara, near the coast, started on a more extended journey through the region of steppes between Kilimanjaro and Victoria Nyanza, afterwards exploring the head-streams of the Kagera, the ultimate sources of the Nile. In the steppe region referred to he discovered two new lakes, Manyara and Eiassi, occupying parts of the East African valley system This region was again traversed in 1893–94 by Count von Götzen, who continued his route westwards to Lake

[1] Another great traveller of this stamp was Wilhelm Junker, who spent the greater part of the period 1875–86 in the east central Sudan.

Kivu, north of Tanganyika, which, though heard of by Speke over 30 years before, had never yet been visited. He also reached for the first time the line of volcanic peaks north of Kivu, one of which he ascended, afterwards crossing the great equatorial forest by a new route to the Congo and the west coast. Valuable scientific work was done in 1893 by Dr. J. W. Gregory, who ascended Mt. Kenya to a height of 16,000 feet. In 1893–94 Scott Elliot reached Ruwenzori by way of Uganda, returning by Tanganyika and Nyasa, and in 1896 C. W. Hobley made the circuit of the great mountain Elgon, north-east of Victoria Nyanza. In 1890 Mt. Kenya was ascended to its summit by a party under H. J. Mackinder. The exploration of Mt. Kilimanjaro has been the special work of Dr. Hans Meyer, who first directed his attention to it in 1887. The region south of Abyssinia proper and north of Lake Rudolf, being largely the basin of the Sobat tributary of the Nile, was traversed by several explorers, among whom may be mentioned Capt. M. S. Wellby, who in 1898–99 explored the chain of small lakes in south-east Abyssinia, pushed on to Lake Rudolf, and thence traversed hitherto unknown country to the lower Sobat. Other valuable expeditions of exploration and surveying were conducted by Donaldson Smith (1899–1900), Maj. H. H. Austin (1899–1901), Maj. A. St. H. Gibbons (1895–96, 1898–1900), Commander B. Whitehouse (1904–06), Lieut. Boyd Alexander, Sir H. H. Johnston, Maj. Powell-Cotton, and the duke of Abruzzi

The first journey through the whole length of the continent was accomplished in the last two years of the century when a young Englishman, E. S. Grogan, starting from Cape Town, reached the Mediterranean by way of the Zambezi, the central line of lakes and the Nile. Other travellers followed in Grogan's footsteps, among the first Maj. Gibbons.

Additions to topographical knowledge were made from about 1890 onwards by the international commissions which traced the frontiers of the protectorates of the European powers. The Anglo-French commission in 1903 traced the Nigerian frontier from the Niger to Lake Chad, and in 1903–04 the Anglo-German commission fixed the Cameroon boundary between Yola, on the Benue, and Lake Chad. In 1901–02 a German Congolese commission surveyed Lake Kivu and the volcanic region north of the lake, while the Anglo-German boundary commission of 1902–04 surveyed the valley of the lower Kagera and fixed the exact position of Albert Edward Nyanza.

At the same time administrative needs forced the governments concerned to take in hand the survey of the countries under their protection. Before the close of the first decade of the 20th century tolerably accurate maps had been made of the German colonies, of a considerable part of West Africa, the Algerian Sahara, and the Anglo-Egyptian Sudan, mainly by military officers.

## PARTITION AMONG EUROPEAN POWERS

In the last quarter of the 19th century the map of Africa was transformed. After the discovery of the Congo the story of exploration takes second place; the continent becomes the theatre of European expansions. Lines of partition, drawn often through trackless wildernesses, marked out the possessions of Germany, France, Great Britain, and other Powers. Railways penetrated the interior, vast areas were opened up to civilized occupation, and from ancient Egypt to the Zambezi the continent was startled into new life.

Before 1875 the only European Powers with any considerable interest in Africa were Britain, Portugal, and France.

In North Africa the Turks had (in 1835) assumed direct control of Tripoli, while Morocco had fallen into a state of decay though retaining its independence. A remarkable change had taken place in Egypt, where the Khedive Ismail had introduced a somewhat fantastic imitation of European civilization. In addition Ismail had conquered Darfur, annexed Harar and the Somali ports on the Gulf of Aden, was extending his power southward to the equatorial lakes, and even contemplated reaching the Indian ocean. The Suez canal, opened in 1869, had a great influence on the future of Africa, as it again made Egypt the highway to the East, to the detriment of the Cape route.

In 1875 other European nations—with the occasional exception of Great Britain—were indifferent to Portugal's pretensions, and her estimate of her African empire as covering over 700,000sq m. was not challenged But the area under effective control of Portugal at that time did not exceed 40,000 sq. miles. Great Britain then held some 250,000sq m., France about 170,000sq m, and Spain 1,000sq. miles. The total area of Africa ruled by Europeans did not exceed 1,271,000sq m.; roughly one-tenth of the continent.

Egypt and the Egyptian Sudan, Tunisia, and Tripoli were subject in differing ways to the overlordship of the sultan of Turkey, and with these may be ranked, in the scale of organized governments, the three principal independent states, Morocco, Abyssinia, and Zanzibar, as also the negro republic of Liberia There remained, apart from the Sahara, roughly one-half of Africa, lying mostly within the tropics, inhabited by a multitude of tribes and peoples living under various forms of government and subject to frequent changes in respect of political organization In the whole of this vast region the negro and Negro-Bantu races predominated, for the most part untouched by Mohammedanism or Christian influences. The larger States and Sultanates possessed neither the means nor the inclination to extend their influence beyond their own borders. The exploitation of Africa continued to be entirely the work of alien races.

**Leopold II.**—The causes which led to the partition of Africa are to be found in the economic and political state of western Europe at the time. Germany, strong and united as the result of the Franco-Prussian War of 1870, was seeking new outlets for her energies—new markets for her growing industries, and with the markets, colonies. For different reasons the war of 1870 was also the starting-point for France in the building up of a new colonial empire. In her endeavour to regain the position lost in that war France had to look beyond Europe. To the two causes mentioned must be added others. Great Britain and Portugal, when they found their interests threatened, bestirred themselves, while Italy also conceived it necessary to become an African Power. The struggle was not, however, precipitated by the action of any of the great Powers but by the ambitious projects of Leopold II., king of the Belgians, who, in Sept. 1876, took what may be described as the first definite step in the modern partition of the continent. He summoned to a conference at Brussels representatives of Great Britain, Belgium, France, Germany, Austria-Hungary, Italy, and Russia, to deliberate on the best methods to be adopted for the exploration and civilization of Africa, and the opening up of the interior of the continent to commerce and industry. The conference was entirely unofficial. The delegates who attended neither represented nor pledged their respective governments. Their deliberations lasted three days and resulted in the foundation of "The International African Association," with its headquarters at Brussels. It was further resolved to establish national committees in the various countries represented, which should collect funds and appoint delegates to the International Association. The central idea appears to have been to put the exploration and development of Africa upon an international footing. But it quickly became apparent that this was an unattainable ideal The national committees were soon working independently of the International Association, and the association itself passed through a succession of stages until it became purely Belgian in character, and at last developed into the Congo Free State, under the personal sovereignty of King Leopold.

Stanley's journey down the Congo had stirred ambition in other capitals than Brussels. France had always taken a keen interest in West Africa, and in the years 1875 to 1878 Savorgnan de Brazza had carried out a successful exploration of the Ogowe river to the south of the Gabun. In Portugal, too, the discovery of the Congo, with its magnificent unbroken waterway of more than a thousand miles into the heart of the continent, served to revive the languid energies of the Portuguese, who promptly began to furbish up claims whose age was in inverse ratio to their validity In Jan. 1879 Stanley left Europe as the accredited agent of King Leopold and the Congo committee. De Brazza returned to Africa at the beginning of 1880, and while Stanley,

on behalf of King Leopold, was making treaties and founding stations along the southern bank of the river, de Brazza and other French agents were equally busy on the northern bank.

**The Scramble for Territory.**—Although the Transvaal between the years 1877 and 1881 had become and ceased to be British, in other respects British territory had been extended in South Africa. And in 1883, in order that the trade route to the interior might be kept open for British expansion northward from the Cape Colony, negotiations for the settlement of the western border of the restored republic were opened in London The border was defined in the Convention of London (Feb. 27, 1884), and at the same time the Bechuana peoples were taken under British protection. Subsequently, March 23, 1885, the Bechuanaland Protectorate was extended northwards to 22° S. latitude, and westward to 20° E. longitude. (*See* SOUTH AFRICA, TRANSVAAL, etc.) Before the convention was signed measures had been taken—without British opposition—at Berlin to establish German authority on the west coast between the Orange river and the Portuguese province of Angola; and on Sept. 8, 1884, the German Government intimated to the British Government "that the west coast of Africa from 26° S. latitude to Cape Frio, excepting Walfish Bay, had been placed under the protection of the German emperor." In the same year, through the activities of Gustav Nachtigal, Togo and the Cameroon district were placed under German protection Before either of these events had occurred Great Britain had become alive to the fact that she could no longer dally with the subject, if she desired to consolidate her possessions in West Africa. The British Government had again and again refused to accord native chiefs the protection they demanded. The Cameroon chiefs had several times asked for British protection, and always in vain. But at last it became apparent, even to the official mind, that rapid changes were being effected in Africa, and on May 16, 1884, Edward Hyde Hewett, British consul, received instructions to return to the west coast and to make arrangements for extending British protection over certain regions. He arrived too late to save either Togoland or Cameroon, in the latter case arriving five days after King Bell and the other chiefs on the river had signed treaties with Nachtigal. But the British consul was in time to secure the delta of the River Niger and the Oil rivers district, extending from Rio del Rey to the Lagos frontier, where for a long period British traders had held almost a monopoly of the trade.

Meanwhile the French Government was strenuously endeavouring to extend France's influence in West Africa, in the countries lying behind the coast-line. During the year 1884 no fewer than 42 treaties were concluded with native chiefs, an even larger number having been concluded in the previous twelve-month. In this fashion France was pushing on towards Timbuktu, in steady pursuance of the policy which resulted in surrounding all the old British possessions in West Africa with a continuous band of French territory. On the lower Niger, however, in 1877, Mr. Goldie Taubman (afterwards Sir George Taubman Goldie) conceived the idea of establishing a settled government. Through his efforts the various trading firms formed themselves in 1879 into the "United African Company," and the foundations were laid of something like settled administration. An application was made to the British Government for a charter in 1881, and the capital of the company increased to a million sterling. Henceforth the company was known as the "National African Company," and it was acknowledged that its object was not only to develop the trade of the lower Niger, but to extend its operations to the middle reaches of the river, and to open up direct relations with the great Fula empire of Sokoto and the smaller states associated with Sokoto under a somewhat loosely defined suzerainty.

In North and East Africa also events had moved since 1875. In 1881 France, with the consent of the Powers, undertook to reorganize the finances and administration of the meagre remains of the once splendid and powerful kingdom of Tunis. Two years later, with Lord Granville's circular despatch of Jan. 3, 1883, England's long and onerous tutelage of Egypt began. (*See* EGYPT.) In East Africa, north of the Portuguese possessions, where the sultan of Zanzibar was the most considerable native potentate, Germany was secretly preparing the foundations of German East Africa Italy, too, had obtained a footing on the African continent. The Rubattino Steamship Company as far back as 1870 had bought the port of Assab as a coaling station, but it was not until 1882 that it was declared an Italian colony. This was followed by the conclusion of a treaty with the sultan of Assab, chief of the Danakil, signed on March 15, 1883, and subsequently approved by the king of Shoa, whereby Italy obtained the cession of part of Ablis (Aussa) on the Red sea, Italy undertaking to protect with her fleet the Danakil littoral One other event must be recorded The king of the Belgians had been driven to the conclusion that, if his African enterprise was to obtain any measure of permanent success, its international status must be recognized; and negotiations for the purpose were opened with various governments

**The Berlin Conference 1884–85.**—With these events there had grown up a general conviction that it would be desirable for the Powers interested in Africa to come to some agreement as to "the rules of the game," and to define their respective interests as far as practicable. A treaty between Britain and Portugal, giving undue recognition to Portuguese territorial claims, which was signed by Lord Granville on Feb. 26, 1884, but not ratified in view of the protests it had evoked, brought this sentiment to a head; and it was agreed to hold an international conference on African affairs. The conference assembled at Berlin on Nov. 15, 1884, and after protracted deliberations the "General Act of the Berlin Conference" was signed by the representatives of all the Powers attending the conference, on Feb. 26, 1885. The Powers represented were Germany, Austria-Hungary, Belgium, Denmark, Spain, the United States, France, Great Britain, Italy, Holland, Portugal, Russia, Sweden and Norway, and Turkey. Ratifications were deposited by all the signatory Powers with the exception of the United States. The General Act dealt with six specific subjects: (1) Freedom of trade in the basin of the Congo, (2) the slave trade, (3) neutrality of territories in the basin of the Congo, (4) navigation of the Congo, (5) navigation of the Niger, and (6) rules for future occupation on the coasts of the African continent. For the present purpose, however, the results effected by the Berlin Act may be summed up as follows. The signatory Powers undertook that any fresh act of taking possession on any portion of the African coast must be notified by the Power taking possession, or assuming a protectorate to the other signatory Powers. It was further provided that any such occupation to be valid must be effective. It is also noteworthy that the first reference in an international act to the obligations attaching to "spheres of influence" is contained in the Berlin Act.

Before the General Act was signed the International Association of the Congo was recognized by all the signatory Powers, with the not very important exception of Turkey. Two months later, in April 1885, King Leopold, with the sanction of the Belgian legislature, formally assumed the headship of the new state; and on Aug. 1 in the same year his Majesty notified the powers that from that date the "Independent State of the Congo" declared that "it shall be perpetually neutral" in conformity with the provisions of the Berlin Act. Thus was finally constituted the Congo Free State, under the sovereignty of King Leopold, though the boundaries claimed for it at that time were considerably modified by subsequent agreements.

**Partition Treaties.**—In the 15 years that remained of the 19th century the work of partition was practically completed. The international agreements which determined in the main the limits of the possessions of the various powers are:—

I. The agreement of July 1, 1890, between Great Britain and Germany defining their spheres of influence in East, West, and South-west Africa. This agreement was the most comprehensive of all the "deals" in African territory, and included in return for the recognition of a British protectorate over Zanzibar the cession of Heligoland to Germany.

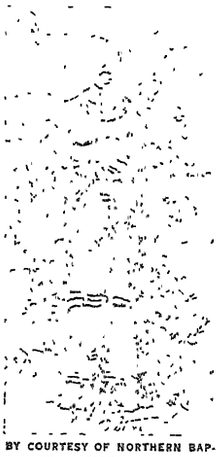
II. The Anglo-French declaration of Aug. 5, 1890, which recognized a French protectorate over Madagascar, French influence in the Sahara, and British influence between the Niger and Lake Chad.

III. The Anglo-Portuguese treaty of June 11, 1891, whereby the Portuguese possessions of the west and east coasts were separated by a broad belt of British territory, extending north to Lake Tanganyika.

IV. The Franco-German convention of March 15, 1894, by which the Central Sudan was left to France (this region by an Anglo-German agreement of Nov 15, 1893, having been recognized as in the German sphere). By this convention France was able to effect a territorial junction of her possessions in North and West Africa with those in the Congo region.

V. Protocols of March 24 and April 15, 1891, for the demarcation of the Anglo-Italian spheres in East Africa.

VI The Anglo-French convention of June 14, 1898, for the delimitation of the possessions of the two countries west of Lake Chad, with the supplementary declaration of March 21, 1899, whereby France recognized the upper Nile valley as in the British sphere of influence



BY COURTESY OF NORTHERN BAPTIST CONVENTION

NATIVE CHIEF IN ROYAL ATTIRE, BELGIAN CONGO
When a chief dies, selected members of his retinue are killed, and buried with him; the village is then abandoned

**The Congo State.**—The Congo Free State, which occupied, geographically, a central position, may serve as the starting-point for the story of the partition after the Berlin Conference. By his will, dated Aug 2, 1889, King Leopold made Belgium formally heir to the sovereign rights of the Congo Free State. Proposals for Belgium to assume responsibility for its administration were made unsuccessfully in 1895 and 1901. Later, the agitation in Great Britain and America against the Congo system of government and the admissions of an official commission of enquiry concerning its maladministration strengthened the movement in favour of transfer, until in 1905 Leopold II. was forced to yield, and the annexation treaty was approved by the Belgian parliament Thus the Congo state, after an existence of 24 years as an independent power, became a Belgian colony. (*See* CONGO, FREE STATE and BELGIAN CONGO.)

**French and British Rivalry.**—After the capture of Khartum and the death of Gen. C. G. Gordon, the Sudan was abandoned to the dervishes. The Egyptian frontier was withdrawn to Wadi Halfa, and the vast provinces of Kordofan, Darfur, and the Bahr-el-Ghazal were given over to dervish tyranny and misrule. It was obvious that Egypt would sooner or later seek to recover her position in the Sudan, as the command of the upper Nile was recognized as essential to her continued prosperity. But the international position of the abandoned provinces was by no means clear. The British Government, by the Anglo-German agreement of July 1890, had secured the assent of Germany to the statement that the British sphere of influence in East Africa was bounded on the west by the Congo Free State and by "the western watershed of the basin of the upper Nile"; but this claim was not recognized either by France or by the Congo Free State. From her base on the Congo, France was busily engaged pushing forward along the northern tributaries of the great river. The desire of France to secure a footing in the upper Nile valley was partly due to her anxiety to extend a French zone across Africa, but it was also to a large extent attributable to the belief, widely entertained in France, that by establishing herself on the upper Nile France could regain the position in Egyptian affairs which she had sacrificed in 1882.

In June 1896 Capt. J. Marchand left France with secret instructions to lead an expedition into the Nile valley. On July 10, 1898, he reached Fashoda, having established a chain of posts *en route*, and here the French flag was at once raised, and a "treaty" made with the local chief. Meanwhile, in 1896, an Anglo-Egyptian army, under the direction of Sir Herbert (afterwards Lord) Kitchener, had advanced southwards for the reconquest of the Egyptian Sudan. On Sept. 2, 1898, Khartum was captured, and the khalifa's army dispersed. It was then that news reached the Anglo-Egyptian commander, from native sources, that there were white men flying a strange flag at Fashoda. The sirdar at once proceeded in a steamer up Nile, and courteously but firmly requested Capt Marchand to remove the French flag. On his refusal the Egyptian flag was raised close to the French flag, and the dispute was referred to Europe for adjustment between the British and French Governments. A critical situation ensued. Neither Government was inclined to give way, and for a time war seemed imminent. Happily Lord Salisbury was able to announce, on Nov 4, that France was willing to recognize the British claims, and the incident was finally closed on March 21, 1899, when an Anglo-French declaration was signed, by the terms of which France withdrew from the Nile valley and accepted a boundary line which satisfied her earlier ambition by uniting the whole of her territories in North, West, and Central Africa into a homogeneous whole, while effectually preventing the realization of her dream of a transcontinental empire from west to east.

**British and Portuguese Spheres Defined.**—In the southern half of the continent, between the years 1885 and 1891, the Portuguese possessions on the west and east coasts were delimited, and Matabeleland and Mashonaland were occupied by the British South Africa Company. (*See* RHODESIA.) The relations between the British and Portuguese territories were determined by the treaty of June 11, 1891. Apart from defining the British and Portuguese spheres both south and north of the Zambezi, it contained many other provisions relating to trade and navigation, providing, *inter alia*, a maximum transit duty of 3% on imports and exports crossing Portuguese territories on the east coast to the British sphere, freedom of navigation of the Zambezi and Shirè for the ships of all nations, and stipulations as to the making of railways, roads, and telegraphs. Portugal was given both banks of the Zambezi to a point ten miles west of Zumbo—the farthest settlement of the Portuguese on the river. The boundary between the Portuguese sphere of influence on the west coast and the British sphere of influence north of the Zambezi was only vaguely indicated; but it was to be drawn in such a manner as to leave the Barotse country within the British sphere. Before the conclusion of the treaty the British Government had made certain arrangements for the administration of the large area north of the Zambezi reserved to British influence. On Feb. 1 Sir Harry Johnston was appointed imperial commissioner in Nyasaland, and a fortnight later the British South Africa Company intimated a desire to extend its operations north of the Zambezi. Negotiations followed, and the field of operations of the Chartered Company was, on April 2, 1891, extended so as to cover (with the exception of Nyasaland) the whole of the British sphere of influence north of the Zambezi (afterwards Northern Rhodesia). On May 14 a formal protectorate was declared over Nyasaland, including the Shiré highlands and a belt of territory extending along the whole of the western shore of Lake Nyasa. The name was changed in 1893 to that of the British Central Africa Protectorate, for which designation was substituted in 1907 the more appropriate title of Nyasaland Protectorate.

**British and German Rivalry.**—In July 1890, the British and German Governments came to an agreement upon the limits of their respective spheres of influence in various parts of Africa, and the boundaries of German South-West Africa were fixed in the position they now hold as those of the territory mandated to the Union of South Africa. These Powers were also the two great rivals on the east coast. Germany, on Dec. 30, 1886, and Great Britain, on June 11, 1891, formally recognized the Rovuma river as the northern boundary of the Portuguese sphere of influence on that coast; but it was to the north of that river, over the vast area of east or east central Africa in which the sultan of Zanzibar claimed to exercise suzerainty, that the struggle between the two rival powers was most acute. By an exchange of notes in Oct.–Nov. 1886, to which the sultan adhered on Dec. 4, 1886, the British and German Governments determined what territories were to be assigned to the sultanate of Zanzibar and agreed to a delimitation of their respective spheres of influence in East Africa. On Sept. 3, 1888, the British East Africa Association

received a charter and became the Imperial British East Africa Company. Shortly afterward the German colony of East Africa was founded. (*See* KENYA COLONY AND PROTECTORATE.)

Meanwhile, in the country to the west and north of the British sphere of influence a contest for Uganda had arisen between Karl Peters and the British East Africa Company. The contest was decided in favour of the latter by the Anglo-German Agreement of July 1, 1890. The provisions relating to East Africa were these:—In return for the cession of Heligoland, Lord Salisbury obtained from Germany the recognition of a British protectorate over the dominions of the sultan of Zanzibar, including the islands of Zanzibar and Pemba, but excluding the strip leased to Germany, which was subsequently ceded absolutely to Germany. Germany further agreed to withdraw the protectorate declared over Witu and the adjoining coast up to Kismayu in favour of Great Britain, and to recognize as within the British sphere of influence the vast area bounded, on the south, by the frontier line laid down in the agreement of 1886, which was to be extended along the first parallel of south latitude across Victoria Nyanza to the frontiers of the Congo Free State, on the west by the Congo Free State and the western watershed of the Nile, and on the north by a line commencing on the coast at the north bank of the mouth of the River Juba, then ascending that bank of the river until it reached the territory at that time regarded as reserved to the influence of Italy[1] in Gallaland and Abyssinia, when it followed the frontier of the Italian sphere to the confines of Egypt. To the south-west of the German sphere in East Africa the boundary was formed by the eastern and northern shore of Lake Nyasa, and round the western shore to the mouth of the Songwe river, from which point it crossed the Nyasa-Tanganyika plateau to the southern end of the last-named lake, leaving the Stevenson road on the British side of the boundary. The effect of this treaty was to remove all serious causes of dispute about territory between Germany and Great Britain in East Africa. It rendered quite valueless Peter's treaty with Mwanga and his promenade along the Tana; it freed Great Britain from any fear of German competition to the northwards, and recognized that her influence extended to the western limits of the Nile valley. But, on the other hand, Great Britain had to relinquish the ambition of connecting her sphere of influence in the Nile valley with her possessions in Central and South Africa. On this point Germany was quite obdurate; and an attempt subsequently made (May 1894) to secure this object by the lease of a strip of territory from the Congo Free State was frustrated by German opposition. (*See* UGANDA; KENYA COLONY AND PROTECTORATE and TANGANYIKA TERRITORY.)



BY COURTESY OF FRED B. PATTERSON

A SWAHILI ELEPHANT TRACKER DRESSED IN SKINS. THESE MEN ARE EXPERTS IN DISTINGUISHING ALL VARIETIES OF SPOORS

On March 31 the union jack was raised, and on May 29 a fresh treaty was concluded with King Mwanga placing his country under British protection. A formal protectorate was declared over Uganda proper on June 19, 1894, which was subsequently extended so as to include the countries westwards towards the Congo Free State, eastwards to the British East Africa protectorate and Abyssinia, and northwards to the Anglo-Egyptian Sudan. The British East Africa protectorate was constituted in June 1895, when the Imperial British East Africa Company relinquished all its rights in exchange for a money payment, and the administration was assumed by the imperial authorities On April 1, 1902, the eastern province of the Uganda protectorate was transferred to the British East Africa protectorate, which thus secured control of the whole length of the so-called Uganda railway, and at the same time obtained access to the Victoria Nyanza.

[1]At this period negotiations between Great Britain and Italy had begun but were not concluded.

**Italy.**—Early in the 'eighties as already seen, Italy had obtained her first formal footing on the African coast at the Bay of Assab (Aussa) on the Red Sea. In 1885 the troubles in which Egypt found herself involved compelled the khedive and his advisers to loosen their hold on the Red Sea littoral, and, with the tacit approval of Great Britain, Italy took possession of Massawa and other ports on that coast In May 1889 the Italians concluded with the negus Menelek the Treaty of Uccialli which, besides settling the frontiers between Abyssinia and the Italian sphere, contained the following article:—

XVII. His Majesty the King of Kings of Ethiopia consents to avail himself of the Italian Government for any negotiations which he may enter into with the other Powers or Governments.

In Italy and by other European governments this article was generally regarded as establishing an Italian protectorate over Abyssinia; but this interpretation was never accepted by the emperor Menelek, and [illegible] Italy succeed in establishing any very effective control over Abyssinian affairs. By May 1894 under various agreements, the Italian and British Governments had fixed the northern limit of the Italian sphere as running from Ras Kasar on the Red Sea to the intersection of the Blue Nile with 35° E. longitude, and settled the boundary between their respective spheres on the Somali coast. But while Great Britain was thus lending her sanction to Italy's ambitious schemes the Abyssinian emperor was becoming more and more incensed at Italy's pretensions to exercise a protectorate over Ethiopia. In 1893 Menelek denounced the Treaty of Uccialli, and eventually, in a great battle, fought at Adowa on March 1, 1896, the Italians were disastrously defeated. By the subsequent Treaty of Addis Ababa, concluded on Oct. 26, 1896, the whole of the country to the south of the Mareb, Belesa, and Muna rivers was restored to Abyssinia, and Italy acknowledged the absolute independence of Abyssinia. By later negotiations with his European neighbours, the emperor Menelek secured boundaries on the south and west more favourable to Abyssinia than those assigned under the Anglo-Italian agreement. And Italian Somaliland, bordering on the south-eastern frontier of Abyssinia, became limited to a belt of territory with a depth inland from the Indian ocean of from 180 to 250 miles.

**Anglo-French Rivalry in West Africa.**—In West Africa the real struggle was between France and Great Britain, and France played the dominant part, the exhaustion of Portugal, the apathy of the British Government and the late appearance of Germany in the field all being elements that favoured the success of French policy. Two phases may be distinguished: the first dealing with the coast colonies, the second with the middle Niger and Lake Chad. On the coast France was wholly successful in her design of isolating all Great Britain's separate possessions in that region, and of securing for herself undisputed possession of the upper Niger and of the countries lying within the great bend of that river. At the date of the Berlin Conference the present colonies of Southern Nigeria and the Gold Coast constituted a single colony under the title of the Gold Coast colony, but on Jan. 13, 1886, the territory comprised under that title was erected into two separate colonies—Lagos and the Gold Coast (the name of the former being changed in Feb. 1906 to the colony of Southern Nigeria). In Aug. 1896, following the destruction of the Ashanti power and the deportation of King Prempeh, as a result of the second Ashanti campaign, a British protectorate was declared over the whole of the Ashanti territories and a resident was installed at Kumasi. But no northern limit had been fixed beyond the 9th parallel, and the countries to the north—Gurunsi (Grusi), Mossi and Gurma—were entered from all sides by rival British, French, and German expeditions. A few days before the meeting of the Berlin Conference Sir George Goldie had succeeded in buying up all the French interests on the lower Niger. The British company's influence had at that date been extended by treaties with the native chiefs up the main Niger stream to its junction with the Benue, and some distance along this latter river. But the great Fula states of the central Sudan were still outside European influence; and the German Government made efforts to secure a footing on the lower Niger until the fall of Prince Bis-

marck in March 1890 On the failure of the half-hearted attempt made later to establish relations with Gando from Togoland, Germany dropped out of the competition for the western Sudan and left the field to France and Great Britain. After its first great success the National African Company obtained a charter from the British Government, and on July 10, 1886, it became "The Royal Niger Company."

Notwithstanding her strenuous efforts, France, in her advance down the Niger from Senegal, did not succeed in reaching Sego on the upper Niger, a considerable distance above Timbuktu, until the winter of 1890–91, and the rapid advance of British influence up the river raised serious fears lest the Royal Niger Company should reach Timbuktu before France could forestall her. In 1892, however, after a troublesome war, France annexed some portion of Dahomey on the coast and declared a protectorate over the rest of the kingdom. Thus was removed the barrier which had up to that time prevented France pushing her way Nigerwards from her possessions on the Slave Coast, as well as from the upper Niger and the Ivory Coast. Henceforth her progress from all these directions was rapid, and in particular Timbuktu was occupied in the last days of 1893 It then appears to have been suddenly realized in France that, for the development of the vast regions which she was placing under her protection in West Africa, it was extremely desirable that she should obtain free access to the navigable portions of the Niger, if not on the left bank, from which she was excluded by the agreement of Aug 5, 1890, then on the right bank, where the frontier had still to be fixed by international agreement On Feb. 13, 1895, a French officer, Commander Toutée, arrived on the right bank of the Niger opposite Bajibo and built a fort. His presence there was notified to the Royal Niger Company, who protested to the British Government against this invasion of their territory; and eventually Toutée was ordered to withdraw, and the fort was occupied by the Royal Niger Company's troops In 1897 the attempt was renewed in the most determined manner. In February of that year a French force suddenly occupied Bussa, and this act was quickly followed by the occupation of Gomba and Illo higher up the river. In Nov. 1897 Nikki was occupied. The situation on the Niger had so obviously been outgrowing the capacity of a chartered company that for some time before these occurrences the assumption of responsibility for the whole of the Niger region by the imperial authorities had been practically decided on; and early in 1898 Capt. F. D. (afterwards Lord) Lugard was sent out to the Niger with a number of imperial officers to raise a local force in preparation for the contemplated change The advance of the French forces from the south and west was the signal for an advance of British troops from the Niger, from Lagos, and from the Gold Coast protectorate. The situation thus created was extremely serious The British and French flags were flying in close proximity, in some cases in the same village. Meanwhile the diplomatists were busy in London and in Paris, and in the latter capital a commission sat for many months to adjust the conflicting claims. Fortunately, by the tact and forbearance of the officers on both sides, no local incident occurred to precipitate a collision, and on June 14, 1898, a convention was signed by Sir Edmund Monson and M. G. Hanotaux which practically completed the partition of this part of the continent. (*See* NIGERIA.)

Thus in its broad outlines the partition of Africa was begun and ended in the short space of a quarter of a century. The result was to divide the continent among the Powers as follows —

| | Square miles. |
|---|---|
| British Africa | 2,101,411 |
| Egyptian Africa | 1,600,000 |
| French Africa | 3,866,950 |
| German Africa | 910,150 |
| Italian Africa | 200,000 |
| Portuguese Africa | 787,500 |
| Spanish Africa | 79,800 |
| Belgian Africa | 900,000 |
| Turkish Africa | 400,000 |
| Independent Africa | 613,000 |
| | 11,458,811 |

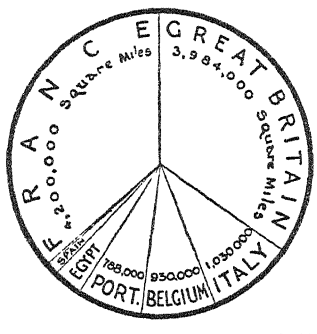
**Anglo-French Declaration, 1904.**—There were still many finishing touches to be put to the structure, but a large contribution to the process was made by the Anglo-French declaration of April 8, 1904, when a series of agreements relating to several parts of the globe were signed in London by Lord Lansdowne, the foreign secretary, and M Paul Cambon, the French ambassador, on behalf of their respective Governments. With regard to Egypt the French Government declared "that they [would] not obstruct the action of Great Britain in that country by asking that a limit of time be fixed for the British occupation or in any other manner." To understand the equivalent engagement taken by Britain, it must be recalled that to consolidate her position in north-west Africa France desired to make her influence supreme in Morocco. In April, 1902, it had been agreed between the French and Shereefian Governments to co-operate in establishing order in the frontier districts of Morocco and Algeria. Meanwhile in the northern districts of Morocco the unrest under the rule of the young sultan, Abd-el-Aziz IV., was attracting attention in Europe and evoking demands for its suppression. It was in these circumstances that in the declaration of April 1904 the British Government recognized "that it [appertained] to France, more particularly as a Power whose [illegible] conterminous for a great distance with those of Morocco, to preserve order in that country, and to provide assistance for the purpose of all administrative, economic, financial, and military reforms which it may require." Both parties, however, "inspired by their feeling of sincere friendship for Spain, [took] into special consideration the interests which that country [derived] from her geographical position and from her territorial possessions on the Moorish coast of the Mediterranean"; and in these interests the French Government undertook "to come to an understanding with the Spanish Government." The understanding was reached later in the same year, and thus Spain secured a sphere of interest on the Moroccan coast immediately facing the Spanish peninsula. Here it may be added that the protectorate of Spain over certain territories on the west coast of Africa, south of Morocco, had been notified to the Berlin Conference, and that by an agreement made with France in 1900 some 70,000sq.m. of the western Sahara were recognized as Spanish; while at the same time France admitted the claim of Spain to the ownership of the district around the Muni river to the south of Cameroons. The action taken by France in Morocco in accordance with the policy marked out in the Anglo-French declaration aroused the resentment of Germany, but on July 8, 1905, the republic secured from the German Government formal "recognition of the situation created for France in Morocco by the contiguity of a vast extent of territory of Algeria and the Shereefian empire, and by the special relations resulting therefrom between the two adjacent countries, as well as by the special interest for France, due to this fact, that order should reign in the Shereefian empire." Finally, in Jan.–April, 1906, a conference of the Powers was held at Algeciras to devise, by invitation of the sultan, a scheme of reforms to be introduced into Morocco (*q.v.*). French capital was allotted a larger share than that of any other Power in the Moorish state bank which it was decided to institute, and French and Spanish officers were entrusted with the organization of a police force for the maintenance of order in the principal coast towns. The new *régime* had not been inaugurated fully, however, when a series of outrages led, in 1907, to the military occupation by France of Oudjda, a town near the Algerian frontier, and of the port of Casablanca on the Atlantic coast of Morocco.

### LATER POLITICAL DEVELOPMENTS

The political map of Africa changed very considerably between 1910 and 1925. In 1910 the British self-governing colonies of the Cape, Natal, Transvaal, and Orange River were formed into the Union of South Africa, with a single government and one legislature. In 1911 a considerable area of French Equatorial Africa was transferred to German Cameroons and in return Germany acknowledged a French protectorate over the greater part of Morocco. On March 30, 1912, a protectorate treaty between France and the sultan was signed at Fez; and by a Franco-Span-

ish convention of Nov. 27 the Spanish zones in Morocco were defined. In 1912, also, Italy annexed the Turkish vilayets of Tripoli and Bengasi (Cyrenaica), to which the common name of Libya was given. In Dec. 1914 a British protectorate over Egypt was proclaimed, but by a declaration of Feb. 1922 Great Britain acknowledged the independence of Egypt. The status of the Anglo-Egyptian Sudan remained unchanged.

In June 1919, by the Treaty of Versailles, Germany renounced possession of all her oversea protectorates in favour of the principal Allied and Associated Powers. These territories, which had all been conquered by the Allies during the World War, were placed under mandatories. The Union of South Africa became mandatory for German South-West Africa; Togoland was divided between France and Great Britain; and France became mandatory for Cameroons, except for a small portion which was placed under the administration of British Nigeria. Britain became mandatory for German East Africa, renamed the Tanganyika Territory, but by subsequent Anglo-Belgian agreements Belgium became mandatory for the provinces of Ruanda and Urundi. In 1920–25 Italy gained additions to Tripoli and Cyrenaica by arrangements with France and Egypt and to Italian Somaliland by arrangement with Great Britain. In 1936, Italy annexed Abyssinia.




HOW AFRICA'S 11 MILLION SQUARE MILES ARE DIVIDED AMONG THE NATIONS. THE FIGURES FOR THE THREE SEGMENTS TOO SMALL TO SHOW ARE: EGYPT, 350,000 SQ.M.; SPAIN, 140,000 SQ.M., AND IN THE SMALLEST SEGMENT, LIBERIA, 40,000 SQ.M.

As a result of these changes Africa was divided among the following Powers. The territories governed under mandate are reckoned in the possession of the Power named:—

| | | | |
|---|---|---|---|
| France . . . | 4,200,000 | Italy . . . . | 1,030,000 |
| Great Britain . . | 3,984,000* | Egypt . . . | 350,000 |
| Belgium . . . | 930,000 | Spain . . . | 140,000† |
| Portugal . . . | 788,000 | Liberia . . . | 40,000 |

*Including Anglo-Egyptian Sudan.
†Including the Spanish zones in Morocco.

These figures give a total of 11,462,000sq m as the area of Africa. In the absence of definite surveys of large areas of the continent this may be regarded as a close approximation to accuracy.

**German Policy.**—The extinction of Turkish rule in North Africa had long been foreseen and was no matter for regret. It ended a connection which had lasted five centuries and had been almost wholly evil in its effects. German sovereignty in Africa had only dated from 1884 and had been rapidly enlarged. Endeavours to extend it further had been a prominent factor in German policy for a decade before the World War. Germany desired a footing on the African coast of the Mediterranean and a port on the Atlantic coast of Morocco. These desires conflicted with Italian and French ambitions, and in 1911 the issue on both points was decided against Germany. As to Morocco, a Franco-German convention of Feb. 9, 1909, had recognized the privileged position of France in Morocco, but not a French protectorate over that country, and the sending of the German gunboat, "Panther," to Agadir, in July, 1911, was a protest against what Germany considered an unwarranted extension of French influence in Morocco, and an intimation that if German treaty rights in Morocco were to be renounced, France must make compensation. The intervention of Great Britain on the side of France put an end to a dangerous situation; Germany, by a convention concluded Nov. 4, 1911, accepted compensation in Central Africa and withdrew opposition to the establishment of a French protectorate in Morocco.

While the Franco-German negotiations were in progress Italy abruptly declared war on Turkey and invaded, and held, Cyrenaica and Tripoli. Thus Germany, who had designed to exploit those vilayets through the medium of an Austro-Hungarian chartered company, was deprived of her last opportunity—short of war—of gaining a [illegible] n the Mediterranean. She turned her attention to the development of a *Mittel Afrika* policy. This policy aimed at securing Germany's supremacy, primarily economic and ultimately political, in central equatorial Africa. The aim was to reserve the Belgian Congo, Angola and Mozambique, north of the Zambezi, as a German sphere, and thus to link up Cameroons with the South-West and East Africa protectorates German industries had need of the raw material tropical Africa produces, and, moreover, southern Angola was a good field for European settlement.

British statesmen were not unfavourable to German expansion in equatorial Africa, so long as it was confined to the economic sphere. In 1898 an agreement, signed by Mr A. J. (afterwards Lord) Balfour and Count Hatzfeldt, had divided Angola and Mozambique into spheres in which Great Britain and Germany respectively were to give financial and economic help to the Portuguese. This was followed in 1899 by the Treaty of Windsor, the object being to reassure Portugal that the Balfour-Hatzfeldt agreement was not in derogation of her sovereign rights in Africa. Neither the agreement with Germany nor the treaty with Portugal was published.

After the settlement of the Morocco crisis, Germany reopened negotiations with Great Britain in respect of Portugal's African colonies, and Prince Lichnowsky (the German ambassador) and Sir Edward (afterwards Lord) Grey reached a new agreement, which was ready for signature in 1913. Nearly all Angola was recognized as a German economic sphere, as well as the northern part of Mozambique. The rest of Mozambique, including Delagoa Bay and the Zambezi valley, was to be a British economic sphere. Sir Edward Grey made it a condition of signing that the 1898 and 1899 documents should be published. The German foreign office raised objections, Herr von Jagow (then foreign minister) stating that the German Press would regard the terms of the Treaty of Windsor and the Lichnowsky agreement as contradictory. In July 1914, however, German consent to publication had been given, but before the new agreement could be signed the World War had broken out.

**The World War.**—During the progress of the campaigns in Africa the whole of the continent, except Abyssinia and the Spanish protectorates, became involved in the struggle. The conquest of the German colonies was foreseen in the negotiation which preceded Italy's entry into the war, and Article 13 of the agreement signed in London on April 26, 1915, between France, Russia, Great Britain, and Italy, laid down that:—

In the event of France and Britain increasing their colonial territories in Africa at the expense of Germany, those two Powers agree in principle that Italy may claim some equitable compensation, particularly as regards the settlement in her favour of the questions relative to the frontiers of the Italian colonies of Eritrea, Somaliland and Libya, and the neighbouring colonies belonging to France and Great Britain.

**Italian Ambitions.**—Italian ambitions had gone beyond the readjustment of frontiers; in particular Italy wished to acquire Jibuti, the port of French Somaliland and the starting place of a railway to Abyssinia. As Jibuti was the only French port on the Suez canal route to the East and to Madagascar, as well as the only approach to Abyssinia that France possessed, she declined to entertain proposals for its surrender.

Italy, however, obtained from France a welcome rectification of the Tripoli-Tunisia frontier, as well as valuable concessions in Tunisia.

In regard to the Cyrenaica-Egyptian frontier, the British Government, in 1919, offered Italy a readjustment of territory in the Libyan desert. The negotiations had not been concluded when Egypt was granted independence and after that time they were conducted directly between Italy and Egypt. They turned largely on the possession of the oasis of Jaghbub, a place of some strategic importance, where is also the tomb-mosque of the founder of the Senussi sect. On Dec. 6, 1925, an Italo-Egyptian agreement was signed, by which Jaghbub was included in Cyrenaica. The wells to the west of El Sollum were included in

Egyptian territory, thus giving El Sollum a needed water supply. South of Siwa the frontier was drawn along longitude 25° E. to the boundary of the Anglo-Egyptian Sudan in latitude 22° North.

Meanwhile Mussolini pressed again for a sphere of influence in Ethiopia. Notes were exchanged with England in 1925 undertaking to support the latter's request for the right to build a dam at Lake Tana in return for support for Italy's demand for a sphere in western Ethiopia. When England, seeing an opportunity to get the dam built by Egyptian and American interests, crossed the Italian cause, Mussolini turned first to France and then in 1935 to direct aggression upon Abyssinia (*q.v.*). The war of conquest by Italy stirred the entire world. It was a direct assertion of white supremacy over a native and independent sovereignty which, in Sept. 1923, had been admitted to the League of Nations. In May 1936 Abyssinia was subdued and annexed. With Eritrea and Italian Somaliland, this ancient kingdom is included in an East African dependency over which the King of Italy has been declared Emperor.

**France and Spain.**—In the same year (1912) that France obtained her protectorate in Morocco she concluded an arrangement with Spain whereby a Spanish protectorate was set up in the northern part of the sultanate, the port of Tangier and a small area around it being made, however, an international zone. In the French protectorate Marshal Lyautey, the resident-general, adopted a bold and conciliatory policy and won the confidence and respect of the Moors. He was succeeded in 1925 by M. Theodore Steeg, the governor-general of Algeria. In their zone the Spaniards met with determined opposition, largely owing to the uprise of a Moor, styled Abdel-Krim. In the territory known somewhat vaguely, as Er-Rif, there seems to have been, as in the coastward portions of Algeria and Tunisia, a much more marked Iberian element in the population than there is in the south of Morocco, and this part of northern Morocco had shown a great hatred of European interference. The Spaniards suffered a severe reverse in 1921 and there was again heavy fighting in 1924 and 1925. In the last-named year the Rifs invaded the French zone, but were defeated and driven back. In the next year the insurrection was successfully quelled; and in 1927 the king and queen of Spain were cordially received. In Southern Rhodesia the growth of a vigorous white community led to that country being made, in 1923, a self-governing colony of the British Empire, and with the assumption of direct imperial control of Northern Rhodesia in 1924 chartered-company rule in British Africa came to an end. In East Africa another vigorous and vocal white community made its influence felt, namely the settlers in the British East Africa Protectorate, which protectorate was annexed to the British Crown in 1920 and renamed Kenya Colony.

A subject which raised large issues was the position of Indians in South and East Africa, but it was of less importance than the growth of race consciousness among the Bantu and the negroes. Increase of education and of Christianity, the employment of large numbers of Africans in industries, and the lessons taught by the World War were among the factors which intensified the feeling of racial unity and led to manifestations of a new anti-white movement. This movement was different from the simple objection to interference by Europeans, or Arabs, previously displayed, and had a consciousness of the need of self-development.

**France in North Africa.**—Apart from the awakening of the African peoples to race-consciousness, two recent developments in the European occupation of the continent are noticeable. France has shown definite progress in the task of restoring north-west Africa to the place in Mediterranean civilization which it held from the 6th century B.C. to the 7th century of the Christian era, when the Mohammedan conquest began. Under British administration the peoples of East Africa have emerged rapidly since the World War to industrial and political advancement. Since 1912, when she acquired the protectorate of Morocco, the authority of France has become increasingly effective in the fertile littoral and high plateaux of the western half of North Africa. The political and economic development of this Mediterranean area upon European lines has been assured by the expansion of Algeria southward and the subsequent linking up of Saharan Algeria with the western Sudan, the French west coast colonies, and French Congo in a vast and coherent African empire. Barely a century ago the French expeditionary force landed at Sidi Ferruch on June 14, 1830. The declared purpose of the French cabinet was "to abolish slavery and piracy, to re-establish the security of navigation in the Mediterranean and open up its southern coasts anew to agriculture, civilization, commerce, and the free access of all nations." In the interval the "restricted occupation" of the coast towns has become the "total occupation" of Algeria, and the conquest of "the South"; while the incorporation of Northern Algeria into France has been followed by the protectorates of Tunis (1881) and Morocco (1912). Within these hundred years the European element in North Africa has risen from a handful of consular officials and merchants to well over a million residents, or approximately to one-tenth of the total population. Great European towns have been built. Agriculture and stock-raising have become infinitely more productive, minerals have been found and worked and new industries introduced. Order and public security have been established in regions to which Rome never sought to penetrate and over peoples that the legionaries strove in vain to subdue. The increasing throng of tourists who yearly traverse North Africa by rail and car from Algiers to the Saharan oases and from Carthage to Marrakesh, and the frequency and regularity of the steamship services which maintain intercourse between the European and African shores of the Mediterranean, are evidence of the success with which France has fulfilled her primary task of re-opening to Europe this lost province of the Graeco-Roman world.

**British Development.**—After the World War appreciable progress was made in the construction of development works and in production in Uganda, Kenya, and Tanganyika (formerly German East Africa); and with a view of [illegible] the economic capacity of these and the neighbouring territories of Zanzibar, Nyasaland, and Northern Rhodesia, the possibility of administrative co-operation between the several governments concerned came under consideration. As the result of conferences on this subject held in 1927 the colonial office appointed the Hilton Young Commission to inquire into the question of the federation, or other union, of the British territories from Northern Rhodesia to Uganda. And, by the desire of its ministry, Southern Rhodesia (which became self-governing in 1923) was included in the scope of the commission. The project of an administrative union, of which this official enquiry into the views of the several governments and populations concerned was the first step, acquires a special interest from the character and geographical position of the colonies affected. Both the East, and the South African colonies are mixed African and European states, in which, although the mass of the inhabitants are African, the European minority is politically dominant. But while, broadly speaking, in the former the numerical predominance and economic importance of the African population are such that the interests of this population have priority in the eyes of the administration over those of the European, in the latter, with the exception of the native territories of the high commission, the European population and its economic importance are so relatively great that European interests stand first. In the East Coast colonies, however, African interests are not so predominant as they are in the (British) West Coast colonies; and in this respect these East Coast colonies hold a position midway between the frankly African West Coast colonies and the frankly European Union of South Africa and Southern Rhodesia. The federation, if effected, of a group of colonies of this intermediate type, by showing whether a central administration is a more effective medium for arriving at a due balance between African and European interests, may be expected to provide data germane to the whole subject of the European tutelage of African peoples. And in particular, as the result of the inclusion of Southern Rhodesia in the purview of the commission and the consequent possibility of Northern Rhodesia or its western portion being incorporated into Southern Rhodesia, it is probable that the question whether Northern Rhodesia, with its large area of 300,000sq.m., is to be

administered as a "plantation" colony or to become a new centre of British population will be at length determined.

**Tangier.**—The status of the Tangier International Zone was regulated by the Act of Algeciras (April 7, 1906), until modified by the conference which formulated the Tangier Statute in 1923. Although certain Powers signatory of the Algeciras Act, notably Italy, withheld their adhesion, this protocol came into force on June 1, 1925. But Spain continued to maintain that the only satisfactory arrangement was the incorporation of Tangier in the Spanish Zone by which it was encircled: while France insisted that her position in Morocco required that Tangier and its communications should be under her control. The visit of a division of the Italian navy to Tangier in Oct. 1927, emphasized Italy's refusal to recognize the statute. On March 3, 1928, agreement was reached between France and Spain. At a second conference (March 20) of France, Spain, Italy and Great Britain the Franco-Spanish Agreement of March 3, was adopted, the statute was modified, and the claims of Italy to participate in the government of Tangier were satisfied (July 17).

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(J. S. K.; H. H. J.; F. R. C.; W. B. W.)

## RECENT EXPLORATION

**Progress Since 1910.**—The largest unknown area of Africa in 1910 was in the Sahara desert; the greatest gaps on the map were in the Libyan desert. In 1920–21 Mrs. Rosita Forbes took an expedition across the Libyan Desert to Kufra, the headquarters of the Senussi Tariq. In 1922–23 Ahmed Bey Hassanein, who had accompanied her, led an expedition through Kufra and the southern oases to Darfur. Mrs. Forbes has made further journeys through Abyssinia, the western Mauretanian desert and western Arabia. Hassanein Bey in 1923 journeyed through the Libyan desert into Darfur and Kordofan. Previous explorations by the French (1912–17) had increased knowledge of the eastern limits of the Chad basin, and had definitely proved its distinction from the western basin of the Nile. Col. Tilho's expeditions had revealed altitudes in Tibesti of 11,200ft. and the height of Mt. Tuside as 10,700ft.; lesser altitudes of 9,800ft. were determined at Jebal Marra, in Darfur, and of 4,000 to 5,000ft. on the western borders of the Sudan. The Tibesti belt of highland probably played a great part in southward spreads of fauna and flora in Miocene and Pliocene times. In the Nilotic Sudan, east of the main Nile, altitudes of 10,000ft. were discovered in 1911–12 by Col. H. D. Pearson. In 1916 Maj. Cuthbert Christy made an interesting journey along the south-western limits of the Nile basin, traversing the ironstone region where adjoining head-streams flow either southwards into the Mbomu and its affluents (Congo basin) or north-east into the Nile basin.



A ZULU WARRIOR IN FULL BATTLE ARRAY

Carefully trained in military tactics, the Zulu warrior was feared by his neighbours as a formidable enemy

French officers, notably Capt. Augiéras, have conducted (from 1904) a scientific survey of the western Sahara, from southern Morocco to the Senegal river and the northern Niger. Augiéras has shown how the intense "desert" conditions of the western Sahara with few oases except on the periphery, accompany the extreme temperatures of the low-lying dunes, which quickly lose heat. The great Juf depression remained unexplored up to 1922; but since then the Citroën expedition from the latitudes of Insalah and Ahaggar in southern Algeria has increased our knowledge of this area. Portuguese Guinea, with its large rivers, has been partly explored, and since 1921 the vast southern part of the Niger basin, and the Black and White branches of the mighty Volta river, have become better known. Northern Togoland, Dahomey, southern Nigeria and the basin of the great Benue river have been mapped in detail.

**East and Central Africa.**—Much intensive work has been done in East and Central Africa. I. N. Dracopoli in 1912–1913 explored part of Jubaland; he reached the Lorian swamp, which receives the waters of the Uaso Nyiro, and showed its connection with the Juba river in Italian Somaliland. In April 1912 G. F. Archer (later Sir) completed surveys connecting the triangulation of British East Africa with the Abyssinian boundary survey. A survey by Capt. E. M. Jack, in 1911, of the region between Lakes Kivu and Victoria added to the knowledge of the Mufumbiro range of active volcanoes; Karisimbi was found to be 14,780ft. high. Since that time the Mufumbiro region and western Uganda have been surveyed in considerable detail. In 1927 geologists of the Swedish Institute found three series of sloping beaches along

the Rift valley between Menengai and Longonot, and also collected much data relative to the glaciation of Mt Elgon and Kilimanjaro, and to the glacial geology of East Africa in general.

The first survey along its whole length of the Congo-Zambezi watershed was made in 1911–14 by Anglo-Belgian and Anglo-Portuguese boundary commissions. Many rivers run for considerable distances parallel to the divide, which is largely bush-covered. Maj. Reginald Walker, one of the British commissioners, discovered that the Luapula, a main headstream of the Congo, did not issue from Lake Bangweulu, but was a continuation of the Chambezi, which passes through the great swamp south of Bangweulu

**Results of the War.**—During the World War, needs of campaigning led to many additions to the knowledge of the topography of inter-tropical Africa, partly through use of aircraft for survey purposes. Thus very useful maps were made of the northern part of Portuguese East Africa. In 1920 Dr. P. Chalmers Mitchell, who flew over the Nile basin proved the value of air reconnaissance to geology by the discovery in the Bayuda desert, north of Khartoum, of the volcanic character of a range of hills A little later the French began to use aeroplanes for survey purposes in the Sahara. (X.)

**AFRICA, ROMAN,** comprised the whole of the continent known to the ancients, except Egypt and Ethiopia. The official and administrative language used the word Africa in a narrow sense, as noticed below. The term was borrowed by the Romans from the language of the natives. In Latin literature it was employed for the first time by the poet Ennius, who used it of the territory of Carthage and the eastern group of the Atlas. Numerous conjectures have been made as to the etymology of the term Africa; the best is that of Charles Tissot, who sees in the word "Africa" the name of the great Berber tribe, the Aourigha (whose name would have been pronounced Afarika), the modern Aouraghen, in ancient times the principal indigenous element of the African empire of Carthage (Tissot, *Géogr. comp.* i. 389). Africa was, in the eyes of the Romans and Carthaginians alike, the country inhabited by the great tribe of Berbers or Numidians called Afarik.

At the time of the Third Punic War the Africa of the Carthaginians was but a fragment of their ancient native empire, the rest of Africa having passed into the hands of the kings of Numidia, who were allies of the Romans.

After the capture of Carthage by Scipio (146 B.C.) this territory became a Roman province, and a trench, the *fossa regia,* was dug to mark the boundary of the Roman province of Africa and the dominions of the Numidian princes. The remains of this ditch, protected by a low wall or a stone dyke, have been discovered (1907); some of the boundary stones which marked its course, and inscriptions mentioning it, have also been found. From Testur on the Mejerda the *fossa regia* can be followed by these indications for several miles along the Jebel esh-Sheid. The ditch ran northward to Tabarca and southward to Tina. The ditch which in later times divided the provinces of *Africa vetus* and *Africa nova* was at the time of the Third Punic War the boundary of Carthaginian territory. The government of the Roman province thus delimited was entrusted to a *praetor* or *propraetor.* The towns which had fought on the side of the Romans during the Third Punic War were declared *civitates liberae,* and became exceedingly prosperous, *e.g.,* Utica, Hadrumetum and Thapsus.

After the Jugurthine war in 106 B.C. the whole of the *regio Tripolitana* on the littoral of the two Syrtes, was annexed to the Roman province. The battle of Thapsus in 46 B.C. made the Romans definitely masters of Numidia which was converted into a new province called *"Africa Nova":* the old province of Africa was known as *"Africa Vetus."*

In 31 B.C. Octavius gave up Numidia, or Africa Nova, to King Juba II. Five years later Augustus gave Mauretania and some Gaetulian districts to Juba, and received in exchange Numidia, which thus reverted to direct Roman control, no longer forming a distinct government, but attached to the old province of Africa. From 25 B.C. the Roman province of Africa comprised the region between the mouth of the Ampsaga (Wad Rummel, Wad el Kebir) on the west, and the two tumuli called the altars of the Philaeni, the immutable boundary between Tripolitana and Cyrenaica, on the east (Tissot ii. 261). In the partition of the government of the provinces of the Roman empire between the senate and the emperor, Africa fell to the senate, and was henceforth administered by a proconsul.

The province of Africa was the only senatorial province whose governor was originally invested with military powers. The proconsul of Africa had command of the *legio III. Augusta* and the auxiliary corps. But in A D 37 Caligula deprived the proconsul of his military powers and gave them to the imperial legate (*legatus Augusti pro praetore provinciae Africae*), whose special duty it was to guard the frontier zone (Tacitus, *Hist.* iv 48; Dio Cass lix 20). The headquarters of the imperial legate were originally at Cirta and afterwards at Lambaesa (Lambessa). The military posts along the frontier of the desert formed an immense arc extending from Cyrenaica to Mauretania. A network of military routes, constructed and kept in repair by the soldiers, led from Lambaesa in all directions, and stretched along the frontier as far as Leptis Magna. The powers of the proconsul scarcely extended beyond the ancient *Africa Vetus* and the towns on the littoral. Septimius Severus detached from the province of Africa the greater part of Numidia to constitute a special province governed by a *procurator,* subordinate to the imperial legate and resident at Cirta (Tissot ii. 34). This province was called Numidia Cirtensis.

In Diocletian's reform, the whole of Roman Africa, with the exception of Mauretania Tingitana (which was attached to the province of Spain), constituted a single diocese subdivided into six provinces. Changes were necessitated by the wars with the Moors and the Vandals. By a treaty concluded in A.D. 476, the Emperor Zeno recognized Gaiseric as master of all Africa. Reconquered by Belisarius in 534, Africa formed, under the name of *praefectura Africae,* one of the great administrative districts of the Byzantine empire. In A.D. 647 the Arabs penetrated into *Ifrikia,* which was destined to fall for ever out of the grasp of the Romans. In A.D. 697 Carthage was taken.

The population of Roman Africa was composed of three chief elements: the indigenous Berber tribes, the ancient Carthaginians of Phoenician origin and the Roman colonists. The Berber tribes, whose racial unity is attested by their common spoken language and by the Berber inscriptions that have come down to us, bore in ancient times the generic names of Numidians, Gaetulians and Moors or Maurusiani. Besides the Afri (Aourigha) of the territory of Carthage, the principal tribes that took part in the wars against the Romans were the Lotophagi, the Garamantes, the Misulani or Musulamii, the Massyli and the Massaesyli. African epigraphy has revealed the names of some of their deities: *deus invictus Aulisva;* the god Motmanius, associated with Mercury; the god Lilleus; *Kautus pater;* the goddess Gilva, identified with Tellus (Tissot i. 486). There were also local divinities in all the principal districts. The rock bas-reliefs and other monuments showing native divinities are rare, and give only very summary representations.

During the Roman period the ancient Carthaginians of Phoenician origin and the bastard population termed by ancient authors Libyo-Phoenicians, formed the predominant populations of the towns on the littoral, and retained the Punic language until the 6th century of the Christian era. The municipal magistrates took the title of *suffetes* in place of that of *duumvirs,* and in certain towns the Christian bishops were obliged to know the *lingua Punica,* since it was the only language that the people understood. Nevertheless, the Roman functionaries, the army and the colonists from Italy soon brought the Latin element into Africa, where it flourished with such vigour that, in the 3rd century A.D., Carthage became the centre of a Romano-African civilization of extraordinary literary brilliancy, which numbered among its leaders such men as Apuleius, Tertullian, Arnobius, Cyprian and Augustine.

Carthage regained its rank of capital of Africa under Augustus, when thousands of Roman colonists flocked to the town. Utica

became a Roman colony under Hadrian, and the *civitates liberae, municipia, castella, pagi* and *turres* were peopled with Latins. The towns of the ancient province of Africa which received *coloniae* were very numerous.

The province of Numidia was at first colonized principally by the military settlements of the Romans Cirta (Constantine) and Bulla Regia (Hammam Darraj), its chief towns, received *coloniae* of soldiers and veterans, as well as Theveste (Tebessa) and Thamugas (Timgad). The fine ruins which have been discovered at the last-mentioned place have earned for it the surname of the African Pompeii.

**AFRICAN LANGUAGES.** Language and race have not necessarily common boundaries, but in classifying a group of languages the relation between the two must not be ignored. Apart from recent European immigration, Africa has four main types of people: Pygmy-Bushman, Negro, Hamitic and Semitic. These four races correspond to four types of languages, though the Negro group was later subdivided into two different units, viz., Sudanic and Bantu.

There is a certain unanimity regarding the main divisions, and the five groups: Bushman, Sudanic, Bantu, Hamitic, Semitic, may be considered as finally settled. Problems on which no agreement has been arrived at are: the position of Bushman (and Pygmy), the unity of the Sudanic languages, the relation between Sudanic and Bantu, and the comprehension of the term Hamitic languages

**Semitic Languages.**—These tongues are spoken in Abyssinia, probably as a result of colonization from southern Arabia. Ge'ez is extinct, Amharic (*q.v.*) is in part a modern representative of Ge'ez Out of Amharic two new languages have evolved: Tigre and Tigrinya. Other dialects are those of Gurague and Harar. Of greater importance is Arabic, which is the ruling language in north Africa and in parts of eastern Sudan; through Islamic influence it has become a literary idiom in east Africa and the Sudan.

**Bushman Languages.**—The Bushman tribes speak a number of languages, which, however, are all allied and may be divided into three groups, southern, central and northern. Phonetically they are remarkable for the occurrence of the so-called clicks (*q.v.*). Another feature, not only in Bushman languages, but also in Hottentot, Sudanic and Bantu, is intonation.

Each syllable, and sometimes also a single-voiced consonant, has its own level of tone, which is as essential a part of a word as the sounds. Words with identical sounds, but differing in tone, have no etymological relation whatever to each other.

A number of the features of the Bushman languages are found in Sudanic languages, *e.g.*, intonation, monosyllabism, non-distinction between verb and noun in form, position of the genitive, formation of plural by "they," but as no etymological relations have as yet been ascertained it seems premature to ally the Bushman languages with the Sudanic group.

No Pygmy language is known. The Pygmies use their neighbours' speech. There seems to be evidence that some groups use a different mode of speech—yet unrecorded—in internal life.

**Sudanic Languages.**—This group is found, roughly speaking, in the stretch of the continent situated between the Atlantic ocean (Senegambia-Cameroons) and the western slopes of Abyssinia. Some enclaves, as Nuba and Kunama in the north, Gaya and Nyifwa-Kavirondo in east Africa, lie beyond this region.

This large group, stretching through the whole breadth of the continent, does not form a unit in the same sense as do the Bantu languages. It is broken up into numerous subdivisions, each of which has evolved its own type, and in the case of some tongues the divergences are so great that up to the present time, their relationship with others has not been demonstrated. The Sudan has been invaded over its whole area from time immemorial by peoples and languages from north and east. Linguistic conditions to-day are the result of this constant movement and shifting, which modified or destroyed original units and created new ones. Languages, probably whole groups of languages, have perished, or scanty remains have been embodied in new formations. As the invading tongues were largely of types differing radically from the Sudanic, these changes were radical and deeply influenced the original character of the language. Thus languages like Kanuri, Wolof and others, have been so transformed that as yet their inclusion in the Sudanic group may seem to be merely theoretical.

**Common Substratum.**—While it is thus necessary to emphasize the highly complicated linguistic situation in the Sudan, and the present incomplete [illegible] of many problems involved, yet the Sudanic group as a whole shows certain common characteristics in phonology and structure, and there are also etymological relationships. There exists a common substratum of Sudanic speech, which is strongest where the original Negro element is strongest in population. This common substratum justifies the use of the term Sudanic languages. Some illustrations may be given: (1) the prevalence of intonation. (2) Monosyllabic stems (Ewe *ku* "death," Nuba *tu* "belly"). (3) Nouns are formed from verbs by a vocalic or nasal prefix (Yoruba *ra* "to buy," *o-ra* "buyer," Shilluk *bugo* "to press the bellows," *o-buk* "bellows"). (4) Plural of nouns is formed by adding to the noun a plural noun or pronoun (Ewe *ati* "tree," *ati-wo* "trees," Nuer *chak* "tick," *ke-chak* "ticks," *-wo* and *ke-* are the pronouns of the third person plural in Ewe and Nuer). (5) Plural of nouns is formed by adding *i* or *a* (Ibo *o-ru* "slave," *i-ru* "slaves"; Nuer *bel* "artist," *bel-i* "artists", Edo *o-ya,* pl. *a-ya* "man"; Zande *boro,* pl. *a-boro* "man"). (6) Distinction between inanimate things and animate beings (or persons), the latter in most cases having the affix *"o"* (Twi *o-nipa* "man"; in Shilluk *o* designates persons as descendants of other persons: *nayo* "the mother's brother," *o-nayo* "the mother's brother's child"). There is no grammatical sex-distinction. (7) In genitive relation the possessor precedes the possessed (Twi *nipa dua* "a man's figure," Kunama *Ila masa* "Ila's lance"). (8) There is no formal distinction of case. The dative form is circumscribed by the verb "to give" (Ewe *edi ga na fofo* "he sought money gave father": he sought money for the father. Nuba *ir iga tir onam* "you say give him": you say to him. (9) Postpositions, *i.e.,* space-denoting nouns, are used in the place of [illegible] (Ewe *ati ta* "tree's head": on the tree; Nuba *ka tu* "house's belly": in the house. (10) Verbal combinations are frequent (Ewe *tso va na* "take come give": to bring to; Nuba *atta-den* from *ed-ta-den* "take come give": to bring to). (11) The verbal stem is not changed in conjugation; tenses and modes are expressed by adding grammatical form words which in many cases can be traced to original nouns or verbs (in Twi the future is formed by prefixing *ba* [from *bia*] "to come," in Nuba by prefixing *bi* "to come"). (12) Sounds peculiar to the majority of Sudanic languages are the labio-velar *kp* and *gb*. (13) A considerable number of word-stems are identical. The characteristics just mentioned are not found in each sub-group, but there is no group which does not possess a number of them.

**Divisions.**—The Sudanic family may be geographically divided into an eastern, a central and a western group. The largest section of the eastern group are the Niloto-Sudanic languages comprising Shilluk with its many subdivisions, Dinka, Nuer and probably also Burun between the White and Blue Niles. Nuba on the Nile, in the Nuba mountains and in Kordofan, is connected with the Nilotic group, while other languages of these mountain regions are of a distinct character, having a class division of the noun.

The central group stretches between the 30th and 10th degree east long, and is subdivided by Delafosse into (*a*) Nile-Congo group, which, however, contains languages that are more closely related to the eastern Sudanic group; (*b*) Ubangi group; (*c*) Shari-Wadai group; (*d*) Shari group; (*e*) Niger-Tshad group; (*f*) Niger-Cameroons group. Our present knowledge concerning the central Sudanic group is so insufficient that the grouping just given is only provisional.

The western Sudanic group is better known and the sub-groups are well-defined. They are the following: (1) *The Kwa languages,* spoken on the coast of Upper Guinea between the lower courses of the Niger and St. Paul's River in Liberia. Their subgroups are: (*a*) Ewe-Akan group (Gold Coast, Togo, Dahome); (*b*) Lagoon group in the littoral regions of the Ivory Coast; (*c*) Kru group, reaching from the western Ivory Coast to the mouth of St. Paul's River; (*d*) Yoruba group; (*e*) Nupe group; (*f*) Ibo group; (*g*) Edo group; (*h*) Ijo (*d–h* in Nigeria). In the Kwa

languages the majority of word-stems consists of one consonant and one vowel. Akan *ka* "to remain," *wu* "to die." They have vocalic and nasal nominal prefixes, whose function is to form nouns out of verbs, and which are only absent in Kru. The prefixes do not form class divisions of the noun, except in rudiments.

(2) *Benue Cross River languages.* They partly coincide with Delafosse's Niger-Cameroons group and with Johnston's group A in his Bantu and Semi-Bantu languages, group (*b*) including Johnston's groups B–G, and group (*c*) comprising Johnston's group H The languages of this group have many stems which end in a consonant Efik *wut* "to kill" against Ewe *wu* "to kill." They have the same nominal prefixes as in group (1) (Efik *fime* "to blow," *o-fime* "wind"), but some languages have a system of prefixes which forms classes. As the group lies on the borderline between Sudanic and Bantu, some of its languages represent a stage of transition between the two.

(3) *Middle Togo group.* Most of these occupy a very small area, being situated in the mountainous region between the 7th and 8th degree N. lat.; some of them are disappearing or have already disappeared, being absorbed by Ewe and Akan. Among those which continue to exist are Avatime, Likpe, Adele, Kposso, Kebu The word-stems in this group consist mainly of one consonant and one vowel. Kposso *wu* "to kill." A class division of nouns is formed by prefixes; some languages use class-suffixes besides the prefixes The group stands between groups (1) and (4), having distinct connections with both.

(4) *Gur* (*Goor*) *languages,* in the northern section of the Ivory and Gold Coast, of Togo and of Dahome, and in the adjacent parts of Haute Volta. They include the following subgroups: (*a*) Mossi group (Mossi, Dagomba, etc.), (*b*) Grussi or Gurunsi group, (*c*) Tem group, (*d*) Bargu, (*e*) Gurma group, (*f*) Kilina, (*g*) Senufo or Siena group, (*h*) Songai. The latter is in fact an isolated language having its own type, but is remotely connected with the Gur languages. Stems of the form consonant plus vowel are very frequent, though perhaps not in the majority. Dyan *wu* "to kill." All have class division of nouns by suffixes; Gurma and Tem use prefixes and suffixes.

(5) *West Atlantic languages.* These are found in part of the territory between the Senegal and the Atlantic, with a number of enclaves farther east, and are sub-divided into an eastern group, comprising Temne, Bulom, Limba, Kissi, Gola and Adjukru, and a western group, represented by (*a*) Dyola, (*b*) the Bissao-Bolama cluster (Bola, Sarar, Pepel, Kanyop), (*c*) the Geba cluster (Biafada, Padjade), (*d*) Banyun, Nalu, Bulanda, (*e*) Konyagi, (*f*) Bidjogo, (*g*) Wolof and Serer. Neither in general type nor in phonology and etymology do the members of this group form such a close unit as those of the preceding group. Almost all have class division of nouns; some, as Bulom, Temne, Adyukru, by prefixes, Gola by prefixes and suffixes, Wolof and Serer have suffixes, but also change the beginning consonant, which perhaps points to prefixes. Stems consisting of a consonant and a vowel are frequent (Bulom *wu* "to die"), but they are in a minority.

(6) *Mandingo or Mande languages,* in the western Sudan between groups (4) and (5). They fall into two groups, named after the numeral for "ten" prevailing in each group: (*a*) *Mande tan,* with Bambara, Soninke, Malinke, Dyula, as main representatives, (*b*) *Mande fu,* comprising Susu, the Kpelle-Mende cluster, in Sierra Leone and Liberia (Mende, Kpelle, Gbande, Gbunde, Toma, Mano, Gio), Djalonka in French Guinea, and a number of small languages reaching as far east as the north-west corner of Nigeria (Boko-Busa). In the Mandingo tongues two-syllabic words prevail; many of these are compositions of two monosyllabic stems, each consisting of a consonant and a vowel. There are no word-forming prefixes, except in rudimentary forms. The word may often have a verbal and a nominal meaning: Bambara *ti* "thatch" and "to thatch."

**Bantu Languages.**—These, spreading through the southern half of the continent, form a closely united family with clearly defined features. Though the most prominent of these, the class division of nouns by prefixes, also exists in Sudanic groups, it has in Bantu reached a fuller development and has become the dominating factor in their structure. These prefixes also form the plural; thus *m-swahili* a Swahili, *wa-swahili,* Swahili people, *ki-swahili* the Swahili language The prefix belonging to a noun is repeated (though sometimes in a changed form) before every adjective, noun or pronoun agreeing with the noun; Swahili: *ki-su ki-kali ki-moja ki-me-potea* "knife sharp one has been lost": one sharp knife has been lost; *-su* "knife" has *ki-* as its class prefix, and this is repeated before every word agreeing with *-su* The plural prefix corresponding to *ki-* is *vi-;* thus the plural of the preceding sentence is: *vi-su vi-kali vi-nane vi-me-potea* "eight sharp knives have been lost." The main nominal classes are. (*a*) for "man as an independent personality"; (*b*) for "man in dependent position" (slave, messenger, workman), also for physical agents, spirits, diseases, parts of the human body, animals, plants; (*c*) for objects existing in double or divisible form, the plural also designating collectives and liquids, (*d*) for "customs, usages, tools"; (*e*) for animals; (*f*) for individual objects and abstract nouns; (*g*) for diminutives; (*h*) for infinitives; (*i*) (or rather three) for locatives Clicks (probably borrowed from Bushman and Hottentot) and lateral sounds are peculiar to some South African Bantu languages Intonation is in most tongues not so important as in the Sudanic family. Stress accent is more developed than in the latter, the accent lying generally on the penultimate. Two-syllabic stems are prevalent. There is no grammatical gender, sex being indicated as in Sudanic languages, and no case inflection. The genitive follows the governing noun. The verb has a large number of derivative forms, which afford a remarkable richness in expression, *e g.,* Swahili *vunja* "to break," *vunjika* "to be broken"; *penda* "to love," *pendana* "to love each other"; *takata* "to be clean," *takasa* "to cleanse"; from *pata* "to obtain" the following derivatives may be formed: *patana* "make an agreement," *patanisha* "unite," *patia* "obtain for somebody," *patika* "be seized," *patilia* "reach out for something," *patiliza* "make one vexed," *patilizina* "vex each other."

It is more difficult to group the Bantu languages in subdivisions than the Sudanic languages, where the evolution of independent types is evident at first sight.

According to Homburger, Bantu is divided into the following groups (of the individual languages belonging to each group only a certain number can be mentioned here): (1) Northern or Ganda group (Ganda, Nyoro, Kerewe. (2) Ruanda group (Ruanda, Rundi). (3) North-eastern or Kilimanjaro group (Kikuyu, Kamba, Djagga, Moshi, Siha). (4) Northern group of the east coast (Taveta-Taita, Chassu, Pokomo, Nika, Shambala, Bondei, Zigula, Swahili, Comore, Zaramo, Kami, Matumbi). (5) East African group (Nyamwezi, Nyaturu, Gogo, Hehe, Pogoro, Kaguru, Konde, Yao, Nyanja, Sene, Tete, Chwabo or Kilimane). (6) South-eastern group (Makua, Ronga or Thonga, Gwamba or Hlengwe, Chopi or Lenge, Venda, Sotho, Kololo, Chwana). (7) Zulu group (Kafir or Xosa, Zulu, Tebele, Ngoni). (8*a*) Central group (Tabwa, Bemba, Mambwe, Bisa or Wisa, Lala-Lamba, Senga, Tonga, Subiya). (8*b*) Western group (Herero, Ndonga, Kwanyama, Nyaneka, Mbunda, Luyi, Umbundu, Kimbundu, Lunda, Luba or Lua). (9) Congo group (Congo, Kanioka, Kutsu, Kele, Lolo, Nkundu). (10) North-western group (Bangi, Teke, Kalai or Kele, Galoa, Duma, Benga, Noho, Basa, Duala, Bube, Kwiri, Isubu). This division appears to call for a new investigation based on a careful observation of sound-shifting, for which a good start has been made by van Warmelo in his study on South African Bantu languages.

**Hamitic Languages.**—These represent a linguistic type which is more closely allied with the Semitic than with any other group of African languages. Their main divisions are (1) Eastern Hamitic in north-east Africa, including, among others: Bedauye, Bogos, Danakil, Somali, Galla, Agau, Kaffitsho. (2) Niloto-Hamitic: Masai, Ndorobbo, Tatoga, Nandi, Suk, Turkana, Gimirra. (3) Western Hamitic: The Berber dialects from western Morocco to the oasis of Siwa, Tuareg, and probably the extinct language or languages of the Guanches on the Canary islands. Hausa (*q.v.*), may be called a remoter member of this sub-group. Though it has adopted many elements from neighbouring Sudanic tongues,

its Hamitic affinity cannot be doubted. Hottentot in South Africa also shows certain Hamitic features, but recent investigations, especially those undertaken by Schapera, reveal such undeniable affinities between the Hottentot and Bushman languages (*q.v.*), as can hardly be explained by borrowing, but seem to point to a genetic relation between the two. Distinction of sex, always one of the prominent reasons for including Hottentot in the Hamitic family, is also found in Naron, a Bushman tongue, being in both cases expressed by a suffix. Both Nama and Naron have a dual form besides singular and plural, *|xam* and Nama have inclusive and exclusive forms of the first person plural (including or excluding the person addressed) There are other common features in grammar and a considerable number of words common to both. Schapera's conclusion is "that in spite of the many noticeable differences between them the Hottentot and Bushman tongues must be regarded as belonging to one and the same family of languages."

The characteristic features of Hamitic speech are: (1) Grammatical gender. Schilh masc. *idilli,* fem. *t-idilli-t* "black," Masai *ol dia* "male dog," *e⁊ dia* "female dog," Nama *khoib* "man," *khois* "woman," Hausa *ya* "he," *ta* "she." (2) a richness in plural formation, which may form such distinctions as distributive, collective, general and universal plurality. Bilin *dimmū-rā* "an individual of the cat family," pl. *dimmū-t;* but: *dimmū* "cat," pl. *diāmū* "cats." Chamir *ieslemā* "a Muslim," pl. *ieslem-en,* but *ieslem-en-t* "the Muslim world." In Hausa (*q.v.*), most nouns have several plural forms; *kunba* "finger-nail" has the plural forms *kunbōbī, kunbuna, kunbai, kunbaibai.* Here as in other Hamitic (and Sudanic) languages re-duplication is frequently used in forming the plural. (3) Inner vowel change (ablaut): Shilh *iliwi,* pl. *ilaw-an* "thorn"; *a-fulu,* pl. *i-fel-en* "string" (the changes are, however, caused by vowel-assimilation, and are thus a phenomenon found likewise in Sudanic languages); in verbs: Shilh *of-aji* "I find," *ufi-ji* "I have found." (4) As in Bantu, the genitive follows the governing noun. In Hottentot, however, as in Bushman and Sudanic (and also Bedauye), the possessor precedes the possessed.

**Fulfulde.**—Meinhof includes Fulfulde, the language of the Fulbe, in the Hamitic family, but calls it Proto-hamitic or Prehamitic. Fulfulde has the usual Hamitic genitive position, in which the governing noun precedes the genitive, but other features regarded as Hamitic are absent. Fulfulde has no grammatical gender; there is no different plural form of nouns, and there is no inner vowel change. It is decidedly a class language, *i.e.,* like Bantu and many Sudanic languages it divides nouns into classes by affixes, and this fact separates Fulfulde from the Hamitic stock and draws it near Bantu languages and the Sudanic class languages. The connection between Fulfulde and Bantu is recognized by Meinhof, his opinion being that "originally in the whole of the present Bantu region languages of a Sudanic type were spoken, until from the north tribes with a language similar to Fulfulde penetrated and made themselves lords over the old inhabitants. The result of a mixture of these two elements was Bantu." (c D. Kolonial-Lexikon i. p. 133.) The essential identity of the class-affixes as used in Fulfulde, in Sudanic class languages and in Bantu, in their etymological form as well as in their function, is evident, while in point of vocabulary Fulfulde and Bantu differ widely.

On the other hand there is an original affinity between Bantu and Sudanic languages. This refers not only to class-affixes, but also and still more to etymology. The two families have a considerable number of word-stems in common, and also certain formative elements, apart from class-affixes, are identical in both families.

The situation may be summed up as follows: The Negro population of Africa, comprising the Bantu and the Sudanic speaking peoples, has in etymology and in a number of formative elements a common linguistic substratum. The class division of nouns existing in Fulfulde, in Bantu and in certain Sudanic languages is evidently of common origin, where or from what language it may have originated we do not know.

According to Struck, the number of African languages is as follows: Bushman 11, Sudanic 264, Bantu 182, Hamitic 47, Semitic 10. Many of these occupy a small area, and perhaps not more than 12 are spoken by more than a million people. From the practical point of view, some of the most important African languages are (Semitic): Amharic, Arabic; (Hamitic): Hausa; (Bantu): Ganda, Kikuyu, Kongo, Luba-Lulua, Mbundu, Ngala, Nyanja, Sukuma-Nyamwezi, Ruanda-Rundi, Sotho-Pedi-Chwana, Swahili, Swina-Karanga-Ndau, Zulu-Xosa; (Sudanic): Akan, Dinka-Nuer, Efik-Ibibio, Ewe-Aneho-Dahome, Ibo, Kanuri, Kpelle-Mende, Malinke-Djula-Bambara, Mossi-Dagomba, Nupe-Gbari, Temne, Wolof, Yoruba, Zande.

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**AFRICAN LILY** (*Agapanthus Africanus*), a member of the family Liliaceae, a native of the Cape of Good Hope, from which source it was introduced at the close of the 17th century. It is a handsome greenhouse plant, which is hardy in the south of England and the warmer parts of the United States. The basal, tufted leaves are long, narrow, arching, ½ to 2 ft. long. A central flowerstalk, 2 to 3 ft. high, ends in an umbel of bright blue, funnel-shaped flowers. The plants are easy to cultivate and are generally grown in large pots or tubs which must be protected from frost in winter. During the summer they require plenty of water and are very effective on the margins of lakes or running streams, where they thrive admirably. It may be propagated by dividing the rootstock in early spring or autumn. Dwarf and white-flowered forms are known in cultivation.

**AFRICANUS:** *see* SCIPIO.

**AFRICANUS, SEXTUS** [illegible], a Christian traveller and historian of the 3rd century, was probably born in Libya and lived at Emmaus. He may have served under Septimius Severus against the Osroenians in A.D. 195. He wrote a history of the world (*Χρονογραφίαι*, in five books) from the creation to A.D. 221, calculating the period between the creation and the birth of Christ as 5,499 years, and ante-dating the latter event by three years. This method of reckoning, known as the Alexandrian era, was adopted by almost all Eastern Churches. The history, which had an apologetic aim, is no longer extant, but copious extracts from it are to be found in the *Chronicon* of Eusebius. There are also fragments in Syncellus, Cedrenus and the *Paschale Chronicon*.

Eusebius also gives a letter to Aristeides, and one to Origen, impugning the authority of the book of Susanna. The ascription to Africanus of the *Κεστοί*, a work on agriculture, natural history, military science, etc., has been disputed. Neander suggests that it was written by Africanus before he had devoted himself to religious subjects. For a new fragment of this work see *Oxyrhynchus Papyri* (Grenfell and Hunt), iii. 36 *et seq*

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**AFRĪDI,** the most powerful of the Pathān tribes inhabiting the mountains on the northwest frontier of Pakistan, though less numerous than the Wazīrs. They occupy the eastern spurs of the Safed Koh. Through the north of these runs the Khyber pass, and their centre is the great upland country called Tirah, 6,000 or 7,000 ft. above sea level, of which the Orakzais hold the southern half. The Afrīdi borders are the Peshawar district on the east and north, the Mohmands on the north, the Shinwāris on the west and the Orakzais and Bangash on the south, including the valleys of Bārā and Bāzār. The origin of the Afrīdis is unknown. They have a curiously Jewish cast of features, but have been supposed to be the Aparytai of Herodotus, though for more than 2,000 years their history is untraceable. It is, however, certain that about the 15th century they ousted the Tirahis, doubtless absorbing some of their elements; but their conquests were encroached upon by their neighbours, and it was not until Jahangir's reign that they retook half of Tirah from the Orakzais. Under Akbar they embraced the Roshanīa heresy, but after its suppression they enlisted freely in the Mogul armies and were subsidized to keep open the Khyber pass. But they failed to defend it against Nadir Shah, and were content to levy toll on such trade as filtered through it during the Abdāli and Sikh regimes. On the British annexation their independence was respected, in spite of their appeal to the Indian government to take Tirah, and they were subsidized to protect trading caravans travelling through the Khyber, but their internal feuds rendered it unsafe. In 1897 the Afrīdis enrolled in the Khyber militia made a gallant defense of Landi Kotal, but eventually surrendered. The defection of one of their most turbulent clans, the Zakka Khel, soon involved the whole tribe and the Orakzais as well. This necessitated a regular invasion of Tirah under Sir William Lockhart, and after much hard fighting every part of the country was traversed and surveyed, all the disaffected sections of the tribes being punished, the Zakka Khel being the last to submit. In 1908 an expedition had again to be launched against the Jawakki Khel. The Afrīdis are intensely democratic, the heads of clans having little authority, so that raiders cannot be brought to book or tribal engagements enforced. The tribe has furnished many good soldiers in the Indian army.



ORIENT AND OCCIDENT PHOTO

AN AFRĪDI TRIBESMAN ON THE INDO-AFGHAN BORDER, WITH HIS HOME-MADE "MAUSER"

(H. A. R.)

**Military Operations.**—There were several British expeditions against the separate clans:

1. Expedition against the Kohat pass Afrīdis under Sir Colin Campbell in 1850. The British connection with the Adam Khel Afrīdis commenced immediately after the annexation of the Peshawar and Kohat districts Following the example of all previous rulers of the country the British agreed to pay the tribe a subsidy to protect the pass But in 1850 1,000 Afrīdis attacked a body of sappers engaged in making the road, killing 12 and wounding 6 It was supposed that they disliked the making of a road which would lay open their fastnesses to regular troops. An expedition of 3,200 British troops was dispatched, which traversed the country and punished them.

2. Expedition against the Jowaki Afrīdis of the Bori villages in 1853. When the Afrīdis of the Kohat pass misbehaved in 1850, the Jowaki Afrīdis offered the use of their route instead; but they turned out worse than the others, and in 1853 a force of 1,700 British traversed their country and destroyed their stronghold at Bori. The Jowaki Afrīdis are a clan of the Adam Khel, who inhabit country between the Kohat pass and the Indus.

3. Expedition against the Aka Khel Afrīdis under Colonel Craigie in 1855. In 1854 the Aka Khel, not finding themselves admitted to a share of the allowances of the Kohat pass, commenced a series of raids on the Peshawar border and attacked a British camp. An expedition of 1,500 troops entered the country and inflicted severe punishment on the tribe, who made their submission and paid a fine.

4. Expedition against the Jowaki Afrīdis under Colonel Mocatta in 1877. In that year the government proposed to reduce the Jowaki allowance for guarding the Kohat pass, and the tribesmen protested this by cutting the telegraph wire and raiding British territory. A force of 1,500 troops penetrated their country in three columns, and did considerable damage.

5. Expedition against the Jowaki Afrīdis under Brig. Gen. Sir Charles Paton Keyes in 1877–78. The punishment inflicted by the previous expedition did not prove severe enough, the attitude of the Jowakis continued the same and raids into British territory went on. A stronger force, therefore, of 7,400 British troops, divided into three columns, destroyed their principal villages and occupied their country for some time, until the tribe submitted and accepted government terms. The Kohat pass was afterward practically undisturbed.

6. Expedition against the Zakka Khel Afrīdis of the Bazar valley under Brig. Gen. John Adams Tytler in 1878. At the time of the British advance into Afghanistan, during the second Afghan War, the Zakka Khel opposed the British advance and attacked their outposts. A force of 2,500 British troops traversed their country, and the tribesmen made their submission.

7. Expedition against the Zakka Khel Afrīdis of the Bazar valley under Lieut. Gen. Sir. Frederick Francis Maude in 1879. After the previous expedition the Afrīdis of the Khyber pass had continued to give trouble during the progress of the second Afghan War, so another force of 3,750 British troops traversed their country, and after suffering some loss the tribesmen made their submission. After this both the Khyber and Kohat passes were put on a stable footing, and no further trouble of any consequence occurred in either down to the time of the frontier risings of 1897, when the Afrīdis attacked the Khyber, which was defended by Afrīdi levies.

8. For the Tirah campaign of 1897 *see* TIRAH.

9. In Feb. 1908 the restlessness of the Zakka Khel again made a British expedition necessary.

During World War I the danger of a rising was averted by the decision to double the Afrīdis' allowances. They joined forces with the Afghans in 1919. After their submission in 1921 they cooperated in the construction of the Khyber railway.

*See* W. H. Paget and A. H. Mason, *Record of the Expeditions against the North-West Frontier Tribes* (London, 1884); Sir R. Warburton, *Eighteen Years in the Khyber* (London, 1900); C. C. Davies, "British Relations with the Afrīdis of the Khyber and Tirah," *Army Quarterly*, vol xxiii, 2 (London, 1932) (C. LI.)

**AFRIKANDER BOND,** a party, founded in Cape Colony by the Rev. S. J. du Toit in 1879, aiming at federating South Africa in one independent republic. The official optional use of

Dutch in parliament and the law courts was secured, but under the leadership of Hofmeyr and the influence of Cecil Rhodes its anti-British sentiments were greatly modified. It was always, however, essentially an organization for the promotion of the political supremacy of the Cape Dutch. (*See* also HOFMEYR, JAN HENDRIK; CAPE PROVINCE; and SOUTH AFRICA, UNION OF.)

**AFTERBIRTH,** a term used to include the placenta, foetal membranes and umbilical cord. They are usually expelled from the womb in a single mass 15 to 30 minutes after the birth of the child. The placenta is a soft, beefy red disk, about 8 to 10 in. in diameter and 1 to 1½ in. in thickness. It is the organ by which the mother nourishes the child and is composed largely of capillary loops from mother and child, in close contact. While the mother's blood does not pass into the blood vessels of the child, the constituents necessary for growth pass through the capillary walls into the child's circulation by a process called osmosis, while the waste products in the foetal blood pass in the other direction and are eliminated by the mother. One surface of the placenta is attached to the inside of the womb, whence it draws its maternal blood. The other surface presents the branching blood vessels of the foetus which unite into one artery and two veins. These vessels form the umbilical cord, which usually starts from the middle of the placenta and enters the body of the foetus at the navel. It is about 22 in. long. Around the edge of the placenta can be found the thin torn membrane which envelops the foetus in the womb. It forms the water bag in which the foetus floats, and usually breaks shortly before the birth of the child. If, however, the child is born with the membranes intact, he is said to be born in a caul.

**AFTERDAMP,** in coal mining, a name given to the poisonous choking gas which forms after a mine explosion. It mainly consists of carbon dioxide, and is also known as chokedamp. (*See* CHOKE-DAMP.)

**AFTERGLOW,** a broad high arch of radiance or glow seen occasionally in the western sky above the highest clouds in deepening twilight, or reflected from the high snowfields in mountain regions long after sunset. It is caused by very fine particles of suspended dust in the high atmosphere exercising a scattering effect upon the components of white light. After the eruption of Krakatoa in 1883, a remarkable series of red sunsets appeared all over the world. These were consequent on the spread by atmospheric currents of huge quantities of fine volcanic dust.

**AFTERIMAGE,** the immediate recurrence of a sensation, in like or opposite quality, after the removal of its stimulus. Afterimages are most prominent in vision. If a person gazes steadfastly at a small coloured object for half a minute and then turns his eyes away to a neutral background, he will notice a small coloured spot of complementary hue and brightness. These are called negative afterimages. If the object was red, the afterimage is bluish green; if it was emerald green, the afterimage is pink; if it was dark, the afterimage is light. Positive afterimages resemble the stimulus in brightness and hue and usually last only a few seconds. They are favoured by intense illumination in the stimulus, occurring after the eye has been in the dark. Positive afterimages occur from pressure, temperature and the sensations of bodily movement and posture. There are no afterimages from sounds or odours. (*See* VISION.)

**AFZELIUS, ADAM** (1750–1837), Swedish botanist, was born at Larf, Västergotland, Oct. 8. He founded the Linnaean institute at Uppsala in 1802, and in 1812 became professor of materia medica at the university. From 1792 he had spent some years on the west coast of Africa, and in 1797–98 he acted as secretary of the Swedish embassy in London.

Afzelius died at Uppsala in 1837.

In addition to his various botanical writings he published the autobiography of Linnaeus in 1823.

His brother JOHAN AFZELIUS (1753–1837) known as *Arvidson,* was professor of chemistry at Uppsala; and another brother, PER AF (1760–1843), who became professor of medicine at Uppsala in 1801, was distinguished as a medical teacher and practitioner.

**AFZELIUS, ARVID AUGUST** (1785–1871), Swedish poet, historian and mythologist. From 1828 till his death he was parish priest of Enköping. He collaborated with the learned historian, Erik Gustaf Geijer, in the great collection of Swedish folk songs, *Svenska folkvisor från forntiden* (1814–16). He published also translations of the *Sämunder Edda* and *Herwara-Saga* and a history of Sweden to Charles XII (of which a German translation was published in 1842), as well as original poems.

**AGA** or AGHA, a word, said to be of Tatar origin, signifying a dignitary or lord. Among the Turks it was applied to the chief of the janissaries, to the commanders of the artillery, cavalry and infantry and to the eunuchs in charge of the seraglio. It was also employed generally as a term of respect in addressing wealthy men of leisure, landowners, etc.

**AGADE,** the capital city of "Sargon of Agade." The city is probably identical with Tal-ed-Deir, excavated by Sir E. A. Wallis Budge in 1891. The inscriptions suggest that it was near Sippar, and Langdon identifies it with Sippar-Yakhuru, admitting, however, that the identification is uncertain. At ed-Deir is a massive city wall forming two sides of a triangle; the third side was formed either by the Euphrates or by a canal. The main gate was at the western apex of the triangle. The city appears to have been constructed all at once, primarily as a fortress. Sargon, who is said to have been a gardener of Semitic origin at Kish, overthrew the Sumerian power of Kish and changed his capital to Agade.

BIBLIOGRAPHY.—E. A. Wallis Budge, *By Nile and Tigris* (1920); S. Langdon, *Excavations at Kish* (1924).

**AGADIR,** a town of French Morocco on the Atlantic coast, 6 mi. N. of Wadi Jus. Pop. 5,626. It was the scene of Portuguese fisheries from 1500 and became a commercial centre. It came into prominence during the Moroccan crisis of 1911; in 1912 it passed to France. It has the natural facilities for the best harbour on the Atlantic coast of Morocco, but these remain undeveloped.

**AGA KHAN I,** HIS HIGHNESS THE (1800–1881), the title accorded by general consent to HASAN ALI SHAH (born in Persia, 1800), when he settled in Bombay under the protection of the British government. He was believed to have descended in direct line from Ali by his wife Fatima, the daughter of the prophet Mohammed. Ali's son, Husain, having married a daughter of one of the rulers of Persia before the time of Mohammed, the Aga Khan traced his descent from the royal house of Persia from the most remote, almost prehistoric, times. His ancestors had also ruled in Egypt, as caliphs of the Beni-Fatimites for a number of years, at a period coeval with the crusades. Before the Aga Khan emigrated from Persia, he was appointed by Fateh Ali Shah to be governor general of Kerman and ruled with firmness, moderation and high political sagacity. At last, however, he incurred the mortal displeasure of Fateh Ali Shah. He fled from Persia and sought protection in British territory, preferring to settle down eventually in India, making Bombay his headquarters. In crossing over from Persia through Afghanistan the Aga Khan found opportunities of rendering valuable services to the British army in Afghanistan and thus cast in his lot with the British. A few years later he rendered conspicuous services in the course of the Sind campaign, when he helped Sir Charles Napier in the process of subduing the frontier tribes, a large number of whom acknowledged the Aga's authority as their spiritual head. When he finally settled down in India, his position as the leader of the large Isma'iliah section of Mohammedan British subjects was recognized by the government, and the title of "his highness" was conferred on him, with a large pension. From that time until his death in 1881 the Aga Khan continued to discharge his sacerdotal functions, not only among his followers in India, but toward the more numerous communities which acknowledged his religious sway in Afghanistan, Khurasan, Persia, Arabia, central Asia, and even distant Syria and Morocco. He remained loyal to the British *raj,* and his vast and unquestioned influence among the frontier tribes on the northern borders of India proved of great service in the several expeditions led by British arms. He was also able to check the more turbulent Mohammedans in British India.

He was succeeded by his eldest son, AGA KHAN II. This prince continued the traditions and work of his father and was a member of the legislative council of Bombay.

AGA KHAN III (1877– ) (Aga Sultan, Sir Mohammed Shah), only son of the foregoing, succeeded him in 1885. He was born in 1877 and, under the care of his mother, a daughter of the ruling house of Persia, was given not only the indispensable religious and oriental education but a sound European training. The Aga Khan headed the Moslem deputation in 1906 to the viceroy, Lord Minto, which submitted the case for encouraging abandonment of the studied aloofness of their community from Indian political life; and he was president of the All-India Moslem league, thereupon formed, during its first constructive years. He initiated the fund for raising the Mohammedan college at Aligarh to university status, which was effected in 1920. In the immediate prewar years he did much to soothe Indian Moslem sentiment in respect to the Italo-Turkish and two Balkan wars. He was touring among his followers in east Africa, when World War I broke out; immediately he cabled to the *jamats* or councils of the millions of Isma'iliahs within British territories and on their borders directing his followers to place themselves unreservedly at the disposal of the British authorities. When Turkey was drawn into the struggle the Aga Khan issued a stirring manifesto showing that the Allies had no overt designs on Islam and calling upon the Moslems of the empire to remain loyal and faithful to their temporal allegiance. His influence was reinforced by his intimate contact with leading Allied statesmen and the breadth and liberality of his outlook on the problems of reconstruction. His study of Indian and middle eastern affairs in *India in Transition* (1918) was not without considerable effect in the final shaping of reforms under the India act of 1919, and was consistent in broad principle with his postwar criticisms of the British government's Mesopotamian and Arabian policy.

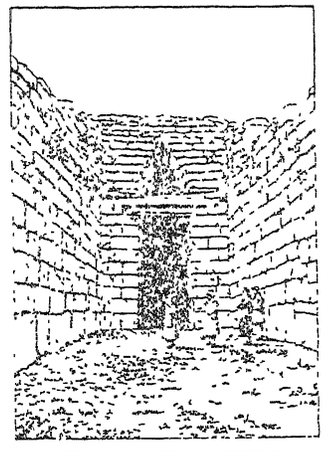
The Aga Khan joined in many representations, public and private, both at the Paris conference and subsequently, as to the immense importance to Great Britain, the ruler of the greatest aggregation of Moslems in the world, of not depriving Turkey of a real [illegible] existence. To the G.C.I.E. and the G.C.S.I. already [illegible] on him there was added in 1916 a salute of 11 guns and the rank and status of a first-class chief of the Bombay presidency, the only previous instance of the grant of a salute outside the Indian territorial ruling families being that of the first Salar Jung. In 1930 and 1931 he was chairman of the British Indian delegation to the Round Table conference held in London to discuss Indian constitutional development. He also represented India at the World Disarmament conference in Geneva in 1932. He led the Indian delegation to the League of Nations assembly from 1932 to 1937 and was the first Indian to be appointed president of the League assembly (1937). Known moreover to the public as a successful breeder and trainer of race horses, the Aga Khan won the Derby with Blenheim in 1930 and with Mahmoud in 1936; and in 1935 his horse Bahram won the Triple crown by carrying off the Two Thousand Guineas, the Derby and the St. Leger.

*See* N. M. Dumasia, *The Aga Khan and His Ancestors* (Bombay, 1939).

**AGALMATOLITE,** a soft variety of the mineral pyrophyllite ($HAlSi_2O_6$), also called *pagodite,* used by the Chinese for carving, especially into grotesque figures (whence called "figure-stone").

**AGAMEDES,** in Greek legend, king of Orchomenus in Boeotia. He and his stepbrother Trophonius were skilled architects and constructors of underground shrines and treasure houses. When building a treasure house for the Boeotian king, Hyrieus, the brothers fixed one of the stones in the wall in such a manner that they could remove it whenever they pleased and help themselves to the treasure. Hyrieus set a trap in which Agamedes was caught; Trophonius to prevent discovery cut off his brother's head and fled with it. He was pursued by Hyrieus, and swallowed up by the earth in the grove of Lebadeia. On this spot was the oracle of Trophonius in an underground cave; those who wished to consult it, first offered a ram and called upon the name of Agamedes. A similar story is told of the treasure of Rhampsinitus by Herodotus (ii, 121). The brothers built the temple of Apollo at Delphi. When they asked for a reward, the god promised them one in seven days; on the seventh day they died.

**AGAMEMNON,** a Homeric hero, son of Atreus, and Aërope, grandson of Pelops, great-grandson of Tantalus and brother of Menelaus. After the murder of Atreus (*q.v.*), Agamemnon and Menelaus took refuge with Tyndareus, king of Sparta, whose daughters, Clytaemnestra and Helen, they respectively married. By Clytaemnestra, Agamemnon had three daughters, Iphigeneia (Iphianassa), Electra (Laodice), Chrysothemis, and a son, Orestes. Menelaus succeeded Tyndareus, and Agamemnon, with his brother's assistance, drove out Aegisthus and Thyestes, and recovered his father's kingdom. He extended his dominion by conquest, and became the most powerful prince in Greece When Paris (Alexander), son of Priam, had carried off his brother's wife, he went around to the princes of the country and called upon them to unite in a war of revenge against the Trojans. He himself furnished 100 ships, and was chosen commander in chief of the combined forces The fleet, numbering 1,200 ships, assembled at the port of Aulis in Boeotia, but was prevented from sailing by calms or contrary winds. Calchas announced that the wrath of Artemis could only be appeased by the sacrifice of Iphigeneia (*q.v.*). The fleet then set sail.



BY COURTESY OF AMERICAN WOMEN'S HOSPITALS

THE TOMB AT MYCENAE, GREECE, KNOWN FOR YEARS AS THE TREASURE HOUSE OF ATREUS, AND CALLED THE TOMB OF AGAMEMNON

Little is heard of Agamemnon until his quarrel with Achilles (*q.v.*). After the capture of Troy, Cassandra, the daughter of Priam, fell to his lot in the distribution of the prizes of war. On his return, after a stormy voyage, he landed in Argolis. Aegisthus, who in the interval had seduced his wife Clytaemnestra, treacherously slew him with her help, Cassandra also perishing. The murder of Agamemnon was avenged by his son Orestes (*q.v.*). Agamemnon is quite possibly a more or less historical character, overlord of the Mycenaean or Achaean states of the Greek mainland. In Hellenistic times, at Sparta, he was worshipped under the title of Zeus Agamemnon. His tomb was pointed out among the ruins of Mycenae and at Amyclae.

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**AGANA,** the capital and largest of 15 cities of the island of Guam, is located on the central portion of the island's west coast, on a sandy beach surrounding Agana bay and at the mouth of the small Agana river. The city is about 5 mi. N.E. of Piti, the port of entry for water shipments with which it is connected by road. Before World War II about half of the population of Guam lived in Agana; the city's 1940 population was 10,004. During the war Agana and many other towns and villages were destroyed and their populations dispersed. The Guam Planning commission was established after the war to rebuild the capital. The city's non-American population is almost entirely Chamorro. The mean annual temperature is about 81° F., and is nearly constant throughout the year. The municipal government is headed by a chief commissioner, a native popularly elected for a four-year term. The city is divided into ten districts or *barrios,* each of which is a group of households with its own chapel and exercising certain powers of local autonomy. Agana was the seat of government under Spain, which ruled Guam for 300 years; the U.S., which acquired the island on Feb. 1, 1899; and Japan, which occupied Guam from 1942 to 1944.

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**AGAPĒ,** the early Christian love-feast (Gr ἀγάπη, "Love"). The word seems to be used in this sense in Jude 12, but *cf* 2 Pet. ii. 13, where the reading is ἀπάταις ("deceits") for ἀγάπαις. The history of the *agapē* coincides, until the end of the 2nd century, with that of the eucharist (*q.v.*), and Tertullian's detailed account (*Apology,* c. 39) of the *agapē* is not, perhaps, exclusive of an accompanying eucharist: "It is the banquet (*triclinium*) alone of the Christians that is criticized. Our supper (*coena*) shows its character by its name. It is called by a word which in Greek signifies love (*i.e., agapē*). Whatever it costs, it is anyhow a clear gain that it is incurred on the score of piety, seeing that we succour the poorest by such entertainments (*refrigerio*). We do not lie down at table until prayer has been offered to God, as it were a first taste. We eat only to appease our hunger, we drink only so much as it is good for temperate persons to do. If we satisfy our appetites, we do so without forgetting that throughout the night we must say our prayers to God . . . After washing our hands and lighting the lamps, each is invited to sing a hymn before all to God, either taken from holy writ or of his own composition. So we prove him, and see how well he has drunk. Prayer ends, as it began, the banquet."

This evidence is good for Africa. But in Egypt about the same time (180–210), Clement of Alexandria (*Paedagogus,* ii. 1) condemns the "little suppers which were called, not without presumption, *agapē.*" This word, he complains, should be used only for the eucharist, not for mere junketings, into which the love-feasts of the church had degenerated. Tertullian too in his tract on fasting (ch. xvii.) mentions grave scandals in connection with the *agapē.*

Ch. xiii. of the tract *About Virginity* (printed among the spurious works of Athanasius) describes a ritual meal which like that in 1 Cor. xi. is *agapē* and eucharist in one, and it is held in a private house, not in church, and the celebrants are holy women.

The historian Socrates (*Hist. Eccl.,* v. 22) records the survival (which he characterizes as singular), around Alexandria and in the Thebaid, of love-feasts combined with the eucharist. So Basil of Cappadocia (Ep. 93), *c.* 350, states that in Egypt the laity, as a rule, celebrated the communion in their own houses, and partook of the sacrament by themselves whenever they chose. In the old Egyptian church order, known as the *Canons of Hippolytus,* there are numerous directions for the service of the *agapē,* held on Sundays, saints' days or at commemorations of the dead. Chrysostom describes (homily 54, tom. v, p. 365) how after the eucharistic synaxis the faithful remained in church, while the rich brought out meats and drink from their houses, and invited the poor, and furnished "common tables, common banquets, common symposia in the church itself." The Council of Gangra (A.D. 343?) anathematized the over-ascetic people who despised "the *agapēs* based on faith." But the holding of *agapēs* in church was forbidden by the councils of Laodicea (363) and Carthage (under Aurelius, 388–423), and later by the council in Trullo (692). In the age of Augustine the *agapē* was frequent.

In the east Syrian, Armenian and Georgian churches, respectively Nestorian, Monophysite and Greek Orthodox in their tenets, the *agapē* was from the first a survival, under Christian and Jewish forms, of the old sacrificial systems of a pre-Christian age. Sheep, rams, bullocks and fowls are given sacrificial salt to lick, and then sacrificed by the priest and deacon, who has the levitical portions of the victim as his perquisite. In Armenia the Greek word *agapē* has been used ever since the 4th century to indicate these sacrificial meals, which either began or ended with a eucharistic celebration. The earlier usage of the Armenians is expressed in two rules recorded against them by a renegade Armenian prelate named Isaac, who in the 8th century went over to the Byzantine church (Combefisius, *Historia Monothelitarum,* col 317). Older mss. of the Greek Euchologion contain numerous prayers to be offered over animals sacrificed; and in the form of *agapē* such sacrifices were common in Italy and Gaul on the *natalis dies* of a saint, and Paulinus of Nola, in his Latin poems, describes them (c. 400) in detail. Gregory the Great sent to Mellitus, bishop of London, a written rite of sacrificing bulls for use in the English Church of the early 7th century. In Augustine's work against Faustus the Manichean (xx 4), the latter taxes the Catholics with having turned the sacrifices of the heathen into *agapēs,* their idols into martyrs, whom they worship with similar rites. The early Christian *agapē* admitted of adaptation to the older funeral and sacrificial feasts, and was so adapted. The association in the synoptics of the earliest eucharist with the paschal sacrifice provided a model, and long after the eucharist was separated from the *agapē* on other days of the year, we still find celebrated on the evening of Maundy Thursday the sacrifice of the paschal lamb, immediately followed by an eucharist. The council of Carthage enacted that the eucharist should be received fasting, except on the anniversary of the Lord's supper. It is clear that at an earlier date the *agapē* preceded the eucharist.

**Pagan Analogues.**—In ancient states common meals called *sussitia* (συσσίτια) were instituted, particularly in the Doric States; *e g.,* Lacedaemon and Crete. Plato advocated them, and perhaps the later Jews imitated the Spartan community. Trade and other guilds in antiquity held subscription suppers or ἔρανοι, similar to those of the early Corinthian Church, usually to support the needs of the poorer members. These *hetariai* or clubs were forbidden (except in cities formally allied to Rome) by Trajan and other emperors, as being likely to be centres of disaffection; and on this ground Pliny forbade the *agapē* of the Bithynian churches, Christianity not being a lawful religion licensed for such gatherings. The custom which most resembles the eucharist and *agapē* was that known as *charistia* described by Valerius Maximus ii. 1. 8. a solemn feast for members of one clan, at which those who had quarrelled were at the sacrament of the table (*apud sacra mensae*) reconciled. Ovid alludes to it (*Fasti,* ii. 617).

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**AGAPEMONITES** or Community of the Son of Man. A sect founded in 1846 by the Rev. Henry James Prince, a clergyman of the Church of England (1811–1899). He studied medicine, obtained his qualifications in 1832 and was appointed medical officer to the general hospital in Bath, his native city. Compelled by ill-health to abandon his profession, he entered himself in 1837 as a student at St. David's theological college, Lampeter, where he gathered about him a band of earnest religious enthusiasts, known as the Lampeter Brethren, and was eventually ordained to the curacy of Charlinch in Somerset, where he had sole charge in the illness and absence of the rector, the Rev. Samuel Starkey. His work at this period reveals an almost hypnotic power over his converts; but soon he was mastered by delusions. He persuaded himself that he had been absorbed into the personality of God and had become a visible embodiment of the Holy Spirit. During his illness Mr. Starkey read one of his curate's sermons, and was not only "cured" forthwith, but embraced his strange doctrines, and together they procured many conversions in the countryside and the neighbouring towns. Forbidden the right to officiate in the Church of England, Prince and Starkey established themselves at Weymouth. Money flowed in; and with these resources they obtained the house at Spaxton, which became the "Abode of Love."

On the death of "Brother" Prince, the Rev. T. H. Smyth-Pigott, pastor of the "Ark,"—a branch church established at Clapton, London—became the acknowledged head of the sect. He was born in 1852, of an old Somersetshire county family, and, after a varied career as university man, sailor before the mast, soldier, coffee-planter, curate in the Church of England and evangelist in the Salvation Army, was converted about 1897 to the views of Prince. For five years after this he was not heard of outside his own sect. In Sept. 1902, however, he began to make claims similar to those of his predecessor, and proclaimed himself to be Christ. By the outside world the affair was greeted with mingled ridicule and indignation, and the new Messiah had to be protected by the police from the violence of an angry mob. Scandal was soon renewed through Pigott's relations with his female followers; and in Aug. 1908, an attempt to "tar and feather" him resulted in two men being sent to prison. Later in the month proceedings were instituted against him by the bishop of Bath and Wells under the Clergy Discipline Act.

*See* Law Reports, Court of Chancery, June 4–8, 1860; art. "Agapemone" in Hastings' *Encyclopaedia of Religion and Ethics.*

**AGAPETAE,** a name given to female Christian ascetics who dwelt with men under a vow of continency. This practice essentially belongs to the history of Christian asceticism. Its beginnings can be traced in the earliest Christian times, but it was preserved in monasticism down to the early middle ages.

*See* Hastings, *Encyclopaedia of Religion and Ethics,* "Agapetae"; *see* also ASCETICISM.

**AGAPETUS,** the name of two popes:

AGAPETUS I., pope from 535 to 536, collaborated with Cassiodorus in founding at Rome a library of ecclesiastical authors. King Theodahad sent him on an embassy to Constantinople, where he died, after having deposed Anthimus, the Monophysite bishop of that town, and ordained Menas his successor.

AGAPETUS II., pope from 946 to 955, at the time when Alberic, son of Marozia, was governing the independent republic of Rome under the title of "prince and senator of the Romans." He did his best to restore church discipline and to regain temporal power. His appeal to Otto the Great to intervene in Rome remained without immediate effect, since Alberic's position was too strong to be attacked, but it bore fruit after his death. Agapetus died on Nov. 8, 955.

**AGAPETUS,** a deacon of the church of St. Sophia at Constantinople, and author of a series of exhortations on the duties of a Christian prince, addressed (*c.* 527) to the emperor Justinian. The work was often reprinted, and has been translated into Latin, French and English.

**AGAR,** or AGAR-AGAR, is a gelatinelike product of red seaweeds, made from *Gelidium* and other agarophytes (agar-bearing plants) such as *Gracilaria, Ahnfeltia* and *Pterocladia.* It is best known as a bacteriological culture medium, and is extensively used for food, as roughage, and in making jelly desserts, confectionery, icings, salad dressings, and dairy products. It is employed in canning meat and poultry, in laxative preparations, as a constituent of medicinal pills and capsules, in numerous pharmaceutical and cosmetic creams and jellies, as a dental impression mould base, and in wire-drawing lubricants. Agar is prepared by boiling the agarophytes in water and subsequently purifying and drying the product. It is produced chiefly in Japan, and also in China, Russia, the United States, Mexico, South Africa, New Zealand and Australia It is amorphous and translucent, and may be found on the market in the form of powder, flakes, shreds, or bricks. Agar is insoluble in cold water, but swells considerably, absorbing as much as 20 times its own weight of water. It readily dissolves in boiling water, and is able to set to a firm gel at concentrations as low as ½%. Although a 1% agar sol solidifies at about 104° F., its gel does not melt until about 203° F., showing a striking case of hysteresis. Agar gels carry small negative electric charges. Like other gels, they exhibit syneresis. Chemically, agar is the sulphuric ester of a linear galactan, consisting of a long chain of *d*-galactose residues attached to each other by a 1, 3-glycosidic linkage. This chain is terminated by one *l*-galactose residue which is attached to the rest of the chain through carbon atom 4, and is esterified at carbon atom 6 with sulphuric acid There are probably as many as 53 galactose units to each $SO_4H$ group. In the natural state, agar occurs as a cell wall constituent of the agarophytes, probably existing in the form of its calcium salt, or a mixture of calcium and magnesium salts.

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**AGARIC,** the name applied to fungi with the spores borne on gills (mushrooms), from the generic name *Agaricus.* In pharmacology, a medicinal [illegible] from the fungus *Fomes officinalis,* a polypore growing principally on larch and pine.

**AGASIAS.** There were two Greek sculptors of this name. Agasias, son of Dositheus, signed the statue called the Borghese Warrior in the Louvre. Agasias, son of Menophilus, is the sculptor of another striking figure of a warrior in the museum of Athens. Both belonged to the school of Ephesus and lived about 100 B.C. (*See* Gardner, *Handbook of Greek Sculpture,* ii. p. 475.)

**AGASSIZ, ALEXANDER EMANUEL** (1835–1910), American man of science, son of J. L. R. Agassiz, was born in Neuchâtel, Switzerland, on Dec. 17, 1835. He came to the United States with his father in 1846; graduated at Harvard in 1855, subsequently studying engineering and chemistry, and taking the degree of bachelor of science at the Lawrence scientific school of the same institution in 1857; and in 1859 became an assistant in the U.S. coast survey. Thenceforward he became a specialist in marine ichthyology, but devoted much time to the investigation, superintendence and exploitation of mines, being superintendent of the Calumet and Hecla copper mines, Lake Superior, from 1866 to 1869, and afterwards, as a stockholder, acquiring a fortune, out of which he gave to Harvard, for the museum of comparative zoology and for furthering the study of biology at Harvard and elsewhere upwards of $1,000,000. In 1875 he surveyed Lake Titicaca, Peru, examined the copper mines of Peru and Chile, and made a collection of Peruvian antiquities for that museum, of which he was curator from 1874 to 1885. He assisted Sir Wyville Thomson in the examination and classification of the collections of the "Challenger" exploring expedition, and wrote the *Revision of the Echini* (1872–74) in the reports. Between 1877 and 1880 he took part in the three dredging expeditions of the steamer "Blake," of the U.S. coast survey, and presented a full account of them in 1888. Of his other writings on marine zoology, most are contained in the bulletins and memoirs of the museum of comparative zoology; but he published in 1865 (with Elizabeth Cary Agassiz, his stepmother) *Seaside Studies in Natural History,* a work at once exact and stimulating, and in 1871 *Marine Animals of Massachusetts Bay.* He died at sea on the "Adriatic" bound for the United States on March 27, 1910.

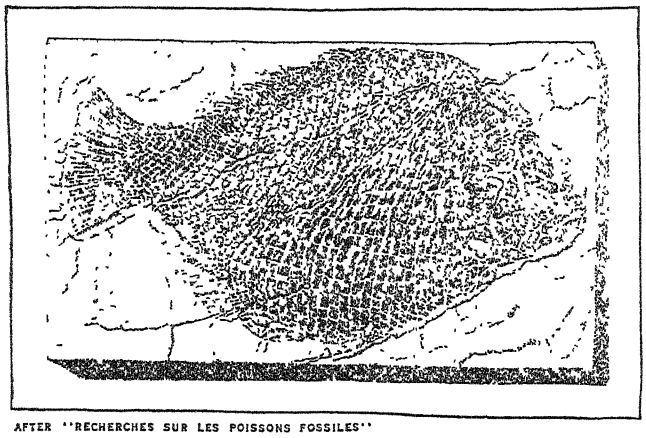
*See* G. R. Agassiz, ed., *Letters and Recollections of Alexander Agassiz; With a Sketch of his Life and Work* (Boston, 1913).

**AGASSIZ, JEAN LOUIS RODOLPHE** (1807–1873), Swiss-American naturalist, geologist and teacher, was born on May 20, 1807, the son of the Protestant pastor of Motier, on the shore of Lake Morat, Switzerland. His father was the last of a long line of clergymen, the first of the series having been driven from France by the revocation of the Edict of Nantes. His mother, Rose Mayor, was a gifted woman from whom especially he inherited his love of animals and plants. In boyhood he spent four years at the gymnasium in Bienne and later attended the academy at Lausanne. He then entered, successively, the universities of Zurich, Heidelberg and Munich. On completion of his academic courses, Agassiz took at Erlangen the degree of Doctor of Philosophy and at Munich that of Doctor of Medicine.

Although as a youth he gave some interested attention to the ways of the brook fish of western Switzerland, his permanent and lifelong interest in ichthyology arose from his being chosen to study the fishes of Brazil. In 1819 and 1820 two eminent naturalists of Munich, J. B. Spix and C. P. J. von Martius, had made an extensive tour in Brazil, bringing back a large collection of

fishes, mostly from the Amazon river The classification of these species was begun by Spix; he died in 1826, however, and the whole collection was then turned over by Martius to Agassiz. The work was completed and published in 1829, as *Selecta Genera et Species Piscium*. This splendid accomplishment was a monument to youthful industry and enthusiasm, the author being at that time only 22 years old The study of fish-forms became henceforth the prominent feature of Agassiz's scientific research. In 1830 he issued a prospectus of a *History of the Fresh Water Fishes of Central Europe*, a valuable contribution printed in parts from 1839 to 1842.

The year 1832 proved the most significant in Agassiz's early career, because it took him first to Paris, then the centre of



AFTER "RECHERCHES SUR LES POISSONS FOSSILES"

A FOSSIL FISH, ETCHED ON STONE UNDER AGASSIZ'S SUPERVISION, AFTER A SPECIMEN DISCOVERED DURING HIS RESEARCHES AT NEUCHÂTEL

general scientific as well as medical research, and afterwards to Neuchâtel where he spent many years of amazingly fruitful effort. While in Paris he lived the life of an impecunious student of the *quartier latin*, supporting himself, helped at times by the kindly interest of friends, such as Humboldt, who soon secured for him a professorship at Neuchâtel, and Cuvier, the most eminent ichthyologist of his time. At Paris his scientific activities largely centred in the Natural History museum of the great park now known as the Jardin des Plantes.

Already Agassiz had become interested in the rich stores of the extinct fishes of Europe, especially those of Glarus in Switzerland and of Monte Bolca near Verona, of which only a few at that time had been critically studied. As early as 1829, Agassiz planned a comprehensive and critical study of these remains. To this end he gathered material wherever possible. His epoch-making work, *Recherches sur les Poissons Fossiles*, appeared in parts from 1833 to 1844. In it the number of named fossil fishes was raised to nearly 1,000, and the ancient seas were made to live again through disclosure of their inhabitants. The great importance of this foundation work rests on the impulse given to the study of extinct life itself. Turning his attention to other extinct animals found with the fishes, Agassiz published in 1839–40 two quarto volumes on the fossil echinoderms of Switzerland, and later (1840–45) his *Études Critiques sur les Mollusques Fossiles*.

From 1832 to 1846 he served as professor of natural history in the University of Neuchâtel, where may still be found evident traces of the activity and enthusiasm of its youngest and most eager teacher. In Neuchâtel he acted for a time as his own publisher, his private residence even becoming a hive of activities. Numerous young men were co-workers with him, dividing between themselves the scanty returns from his lectures and publications. He now began his *Nomenclator Zoologicus*, a catalogue, with references, of all the names applied to genera of animals from the beginning of scientific nomenclature, a date since fixed at Jan. 1, 1758. "This," said Agassiz, "is a work of patience. It is a barrier against the Babel of confusion which threatens to overwhelm the domain of zoological synonomy." The practical value of the compilation can hardly be overestimated.

In 1836 Agassiz began a new line of studies, that of the movements and effects of the glaciers of Switzerland. Several writers had expressed the opinion that these rivers of ice had once been much more extensive, and that the erratic boulders scattered over the region and up to the summit of the Jura mountains, were carried by moving glaciers. On the ice of the Aar glacier he built a hut, the "Hôtel des Neuchâtelois," from which he and his associates traced the structure and movements of the ice. In 1840 he published his *Études sur les glaciers*, in some regards the most important of all his works. In it he was able to show that at a period geologically recent Switzerland was covered by one vast ice-sheet. His final conclusion was that "great sheets of ice, resembling those now existing in Greenland, once covered all the countries in which unstratified gravel (boulder drift) is found"

In 1846 Agassiz was led to visit the United States for the general purpose of studies in natural history and geology, but immediately to give a course of lectures in the Lowell institute in Boston. These were followed by another series in Charleston, and afterwards by lectures both popular and technical in various cities, his brilliant and engaging personality at once winning all hearts. In 1848 he accepted a professorship of zoology at Harvard university, and from that time on became more and more enthusiastically American. Indeed, half his scientific career, and that not the least important, was lived in this country. "He came in a spirit of adventure and curiosity; he stayed because he loved a land where he could think and act as he pleased; a land where nature is rich but tools and workmen are few, and traditions none."

In America his chief volumes of scientific research were the following: *Lake Superior* (1850); *Contributions to the Natural History of the United States* (1857–1863, in several quarto volumes, the most notable being on the embryology of turtles); and the *Essay on Classification*, a brilliant production, which, however, failed to grasp the trend of modern zoology. Besides these extensive contributions appeared a multitude of short papers on natural history and especially on the fishes of America. His two excursions of highest importance were, first, to Brazil in 1865, and second, to California in 1871, the latter trip involving both shores of South America. *A Journey in Brazil* by Mrs Agassiz and himself, published in 1868, gives a very interesting account of their experiences on the earlier voyage. His most important paper on American fishes dealt with the remarkable group of viviparous surf-fishes of California.

During many years, also, Agassiz was deeply absorbed in his cherished plan of developing at Harvard university a comprehensive museum of research in zoology. This institution, which was established in 1859 and ultimately grew into the present splendid museum of comparative zoology, enjoyed his fostering care during the rest of his lifetime. In America Agassiz's industry and devotion to scientific pursuits were as strongly marked as in Europe, but two other traits here assumed a much greater importance. As a teacher of science he was extraordinarily skilful, certainly the ablest America has ever known. In addition he was personally devoted to his students, who were in the highest sense co-workers with him—"the best friend that student ever had." His warmth of feeling moreover went out equally to colleagues and neighbours. It was said that "one had less need of an overcoat in passing Agassiz's house than any other in Cambridge." Such qualities, endeared him to all, while his amazing command of lucid and picturesque English impressed every listener. He was also as much at home before an audience of labourers or farmers as with the most erudite leaders of research.

Agassiz's method as teacher was to give contact rather than information. He discouraged the use of books except in detailed research. Among his favourite expressions were "If you study nature in books, when you go out-of-doors you cannot find her." "It's not text-books we want, but students. The book of nature is always open." "Strive to interpret what really exists." The result of his instruction at Harvard was a complete revolution in natural history study in America. The purpose came to be not a category of facts taken from others, but the ability, through contact, to gather the needed facts. As a result of his activities

every notable teacher of natural history in the United States for the second half of the 19th century was at some time a pupil of Agassiz or of one of his students.

In the interests of better teaching and of scientific enthusiasm, he organized in the summer of 1873 the Anderson school at Penikese, an island in Buzzard's bay. The details of this remarkable venture, brief in actual period but having a profound effect on science teaching and the precursor of all American summer schools and establishments for marine research, cannot be given here. But "the school of all schools which has had the greatest influence on science teaching in America was held in an old barn on an uninhabited island, 18 miles from the shore; it lasted but three months; it had virtually but one teacher. It existed in the personal presence of Agassiz. When he died, it vanished." (David Starr Jordan, *Agassiz at Penikese.*)

As Agassiz was beyond question one of the ablest, wisest and best informed of the biologists of his day, it is often asked why his attitude towards Darwinism was, throughout all his lifetime, cold and unsympathetic. It seems possible that his position was determined in part by a misunderstanding, but more particularly by his philosophy of biology. He seemed to regard Darwinism as a theory of continued progress instead of one of divergence, tempered by the weeding out of unadapted individuals. He failed to recognize the importance of separation and segregation in the development of new specific forms. He once said that in his studies of fossils he "was on the verge of anticipating Darwinism," but was withheld by the discovery that "we had the higher fishes first." In a sense this was true, for the brain development of the sharks is higher, as a whole, than that of the bony fishes. But the latter are far more specialized in fitness for aquatic life. More important to Agassiz was the fact that in his philosophy each species of animal or plant was in itself "a thought of God." Their homologies or fundamental unities were "associations of ideas in the Divine Mind." He had an intensely religious mind, although he was totally out of sympathy with sects and creeds and the outer shell of Christianity.

In physical appearance Agassiz was a striking figure, nearly six feet tall, compactly built, with noble head and broad handsome face, usually illuminated by an especially charming smile. This last, however, would suddenly turn into a frown in the presence of careless or trivial work or pretence on the part of a student. He married twice. His first wife, Cecile Braun, was the sister of an eminent botanist. In 1850, after his first wife's death, Agassiz married Elizabeth Cabot Cary, of Boston, well known as a writer and as a promoter of the education of women.

Agassiz died on Dec. 12, 1873. He was buried in Mt. Auburn at Cambridge, and by his grave stands a boulder from the moraine of the Lauteraar. At his death, Theodore Lyman, one of his students, wrote, "We buried him from the chapel that stands among the college elms. The students laid a wreath of laurel on his bier and their manly voices sang a requiem. For he had been a student all his life long, and when he died he was younger than any of them."

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(D. S. J.)

**AGATE**, a term applied, not to a distinct mineral species, but to a group of amorphous and crypto-crystalline forms of silica. According to Theophrastus the agate (ἀχάτης) was named from the river Achates, now the Drillo in Sicily, where the stone was originally found. Most agates occur in eruptive rocks or ancient lavas where they fill the cavities which were produced by the liberation of gas during the solidification of the molten rock. These agates have a banded structure, successive layers being approximately parallel to the sides of the cavity. A number of varieties of agate are characterized by peculiarities in the shape and colour of the bands, which are seen in sections cut at right-angles to the layers. In riband-agate they are straight or slightly curved. Such an agate with cloudy bands alternating with bands of another colour, the two sets being sharply marked off from one another, is known by the general term onyx. A ring or eye agate is one in which the differently coloured bands are disposed in concentric circles. A Mexican agate, showing only a single eye has received the name of "cyclops." When the banding forms re-entrant and salient angles, its outline resembling that of the plan of a fortress, it is called fortification-agate. Certain agates also occur, to a limited extent, in veins, of which a notable example is the beautiful brecciated agate of Schlottwitz, near Wesenstein in Saxony—a stone mostly composed of angular fragments of agate cemented with amethystine quartz. A variety having included matter of a green colour, embedded in the agate and disposed in filaments and other forms suggestive of vegetable growth, is known as moss agate. Dendritic markings of black or brown colour, due to infiltration of oxides of manganese and iron, produce the variety known as Mocha stone.

It is probable that agates occurring in cavities in igneous rocks have been formed in a number of ways, and various theories of their origin have been proposed. The theory which is now generally accepted is as follows. During the solidification of the rock an accumulation of gas or steam causes a bubble to form. Long after, when the rock has solidified, water carrying silica in solution, probably as alkali silicate, penetrates into the region where the bubble is located. It then diffuses into the cavity and subsequently the solution coagulates to a silica gel. The alkali present with the silica attacks the iron-bearing rock surrounding the cavity, giving rise to iron salts. These diffuse into the silica gel and produce the regular layers of iron hydroxide after the manner of Liesegang's rings. Finally the whole mass gradually hardens with loss of water and crystallization of much of the silica as quartz or chalcedony. During the process of crystallization the coloured bands are not disturbed and hence we have the final agate as it is now found.

Agates are cut and polished chiefly in the Idar-Oberstein district situated on the Nahe, a tributary of the Rhine at Bingen. Here the industry grew up many centuries ago by reason of an abundance of agates in the amygdaloidal melaphyre of the district. The stones used now are mostly imported from Brazil (Rio Grande do Sul) and from Uruguay.

Most commercial agate is artificially stained so that stones naturally unattractive by their dull grey tints come to be valuable for ornamental purposes. The colouring matter is absorbed by the porosity of the stone, but different stones and different layers of the same stone exhibit great variation in absorptive power. To produce a dark brown or black colour, the stone is kept perhaps for two or three weeks in a saccharine solution, or in olive oil at a moderate temperature. After removal from the solution, the agate is well washed and then digested for a short time in sulphuric acid, which, entering the pores, carbonizes the absorbed sugar or oil. Certain layers of chalcedony are practically impermeable and these consequently remain uncoloured, so that an alternation of dark and white bands is obtained, giving rise to an onyx. Agate is stained red, to imitate cornelian and sardonyx, by means of ferric oxide. Other colours are detained in other ways.

Among the uses to which agate is applied may be mentioned the formation of knife-edges of delicate balances, small mortars and pestles for chemical work, burnishers and writing styles, umbrella handles, paper knives, seals, brooches and other ornaments. Real cameos are cut from banded agates, one layer forming the medallion, the other the design in relief.

Agates are found in England in the Cheviot Hills, in the neighbourhood of Bristol and at Lichfield in Staffordshire. In Scotland they occur at Montrose in Forfarshire, in Perthshire, and at many other localities. The majority of agates are produced in countries outside Europe, notably in South America, North America and India; they are also found in South Africa and Australia.

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(W. A. W.)

**AGATHA, ST.,** the patron saint of Catania, Sicily, where her festival is celebrated on Feb. 5. The legend is that she was a native of Sicily (probably of Catania, though Palermo also claims her) of noble birth and great beauty. She repelled the advances of the Roman prefect sent by the emperor Decius to govern Sicily, and was by his orders brutally tortured and finally sent to the stake. As soon as the fire was lighted an earthquake occurred and the people insisted on her release. She died in prison on Feb. 5, 251. The rescue of Catania from fire during an eruption of Mt. Etna was later attributed to St. Agatha's veil.

**AGATHANGELUS, AGATHANGE** or **AKATHANKELOS,** Armenian historian, lived during the 4th century, and wrote a *History of the Reign of Dertad, or Tiridates, and of the Preaching of St. Gregory the Illuminator.* This history was translated into several languages, and Greek and Latin translations are found in the *Acta Sanctorum Bollandistarum,* tome viii. The history consists of three parts, a history of St. Gregory and his companions, the doctrine of Gregory, and the conversion of Armenia to Christianity.

*See* V. Langlois, *Collection des Historiens anciens et modernes de l'Arménie* (Paris, 1868).

**AGATHARCHIDES** or **AGATHARCHUS,** of Cnidus, Greek historian and geographer, lived in the time of Ptolemy Philometor (181–146 B.C.) and his successors. Amongst other works, he wrote treatises on *Asia, Europe* and *the Red Sea.* Interesting extracts from the last, of some length, are preserved in Photius (cod. 213).

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**AGATHARCHUS,** the name of an Athenian painter of the 5th century B.C. He is said by Vitruvius to have been the first to paint a scene for the acting of tragedies.

**AGATHIAS** (*c.* A.D. 536–582), of Myrina in Aeolis, Greek poet and historian. He studied law at Alexandria, completed his training at Constantinople and practised as an advocate (*scholasticus*) in the courts. He wrote a number of short love-poems in epic metre, called *Daphniaca.* He next put together a kind of anthology, containing epigrams by earlier and contemporary poets and himself, under the title of a *Cycle of New Epigrams.* About a hundred epigrams by Agathias have been preserved in the *Greek Anthology.* After the death of Justinian (565), some of Agathias's friends persuaded him to write the history of his own times. This work, in five books, begins where Procopius ends, and is the chief authority for the period 552–558.

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**AGATHO,** pope from 678 to 681, was born in Sicily. He ordered St. Wilfrid to be restored to his bishopric at York in 679, and was the first pope to cease payment of the tribute hitherto paid on election to the emperor at Constantinople. Agatho died on Jan. 10, 681.

**AGATHOCLES** (361–289 B.C.), tyrant of Syracuse, was the son of a potter, born at Thermae Himeraeae (mod. *Termini Imerese*) in Sicily. He removed to Syracuse and served with distinction in the army In 333 B.C. he married the widow of his patron Damas, a distinguished and wealthy citizen. He was twice banished for attempting to overthrow the oligarchical party in Syracuse (*q.v.*); in 317 B.C. he returned with an army of exiles and Campanian mercenaries. He banished or murdered some 10,000 members of the senate and the oligarchical party, proclaiming himself the champion of the people, and thus made himself master of Syracuse. His tyranny was confirmed by a virtually unanimous vote of the people, and, despite his continuous wars, he seems to have been generally popular. He enriched Syracuse with many public buildings, and his reign was looked back to as a period of orderliness and tranquillity. His foreign policy was inevitably part of the almost continuous 200 years' war between the Sicilian Greeks and their secular enemy, Carthage (*q.v.*). In these wars Syracuse had always taken the lead, and Agathocles only continued the policy of Dionysius the Elder, Dionysius the Younger and Timoleon (*qq.v.*).

In 310 B.C. Agathocles, defeated and besieged in Syracuse, took the desperate resolve of breaking through the blockade and attacking the enemy in Africa. He besieged Carthage, which was at the time troubled by internal dissensions, but after several victories he was at last completely defeated (306) and fled secretly to Sicily. After concluding peace with Carthage, Agathocles styled himself king of Sicily and established his rule over the Greek cities of the island more firmly than ever. Even in his old age he displayed the same energy and is said to have been meditating a fresh attack on Carthage at the time of his death, which was followed by a recrudescence of Carthaginian power in Sicily. Agathocles was something more than the typical leader of mercenaries. He was a born leader, who knew how to inspire devotion.

BIBLIOGRAPHY.—*See* Justin xxii., xxiii; Diodorus Siculus xix., xxi., xxii. (follows generally Timaeus who had a special grudge against Agathocles); Polybius ix. 23; Schubert, *Geschichte des Agathokles* (1887); Grote, *History of Greece,* ch. 97; also SICILY: *History.*

**AGATHODAEMON,** an early map designer of Alexandria, who probably lived in the 2nd century A.D. Some manuscripts of the *Geography* of Ptolemy contain 27 maps, which are stated to have been drawn by Agathodaemon of Alexandria, who "delineated the whole world according to the eight books of Ptolemy's geography." About 1470, Nicolaus Doris, a Benedictine monk, produced an edition of them in which the names were inserted in Latin instead of Greek.

*See* Bunbury, *History of Ancient Geography,* ii.

**AGATHODAEMON,** an important god in Greek mythology, the "good spirit" of cornfields and vineyards, protective spirit of individuals and the State. The Greeks drank a cup of pure wine in his honour at the end of each meal (Aristophanes, *Equites,* 106). Often accompanied by *Agathē Tuchē* (good fortune), he may be identified with the Roman *Bonus Eventus* (Pliny, *Nat. Hist.,* xxxvi., 23) and *Genius* (q.v.). He is represented in works of art in the form of a serpent, or of a young man with a horn of plenty and a bowl in one hand, and a poppy and ears of corn in the other.

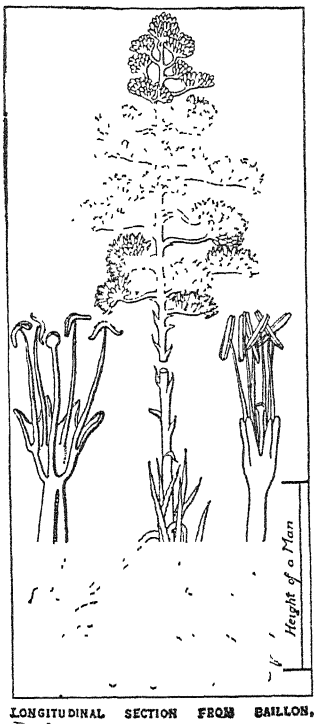
**AGATHON** (*c.* 448–400 B.C.), Athenian tragic poet, friend of Euripides and Plato. He won his first victory in 416 (at the Lenaea), and his plays seem to have been successful, despite their artificial style. He appears to have been the first to invent an original plot, and to write choral odes unconnected with the plot. His effeminacy made him a butt of Aristophanes. Before 406 he retired to the court of Archelaus, where he died.

*See* Aristotle, *Poetica* 9, and 18: Aristophanes, *Thesmoph.* 59, 106, *Eccles.* 100; Plato, *Symp.* 198 c.; Plutarch, *Symp.* 3; Aelian, *Var. Hist.* xiv. 13; Ritsch, *Opuscula,* i.; fragments in Nauck, *Tragicorum Graecorum Fragmenta. See* also Haigh, *Tragic Drama of the Greeks.*

**AGATHYRSI,** a people of Thracian origin, who in the earliest historical times occupied the plain of the Maris (Maros), in the region now known as Transylvania. They are described by Herodotus (iv. 104) as of luxurious habits, wearing gold ornaments (the district is still auriferous) and having wives in common. They tattooed their bodies (Virgil, *Aeneid,* iv. 136), degrees of rank being indicated by the manner in which this was done, and coloured their hair dark blue. Valerius Flaccus (*Argonautica,* vi. 135) calls them Thyrsagetae, probably in reference to their celebration of orgiastic rites in honour of some divinity akin to the Thracian Dionysus. In later times the Agathyrsi were driven farther north, and their name was unknown to the Romans in their original home.

*See* Pliny, *Nat. Hist.* iv. 12 [26], 88.

**AGAVE,** a large botanical genus of the family Amaryllidaceae, chiefly Mexican, but occurring also in the southern and western United States and in central and tropical South America. The plants have a large rosette of thick fleshy leaves generally ending in a sharp point and with a spiny margin; the stout stem is usually short, the leaves apparently springing from the root. They grow slowly and flower but once after a number of years, when a tall stem or "mast" grows from the centre of the leaf-rosette and bears a large number of short, tubular flowers. After development of fruit the plant dies down, but suckers are frequently produced from the base of the stem which become new plants. The most familiar species is *Agave americana* (*see* fig.), a native of tropical America, the so-called century plant or American aloe (the Maguey of Mexico). The number of years before flowering, 5 to 60 or more, but usually about 10, depends on the vigour of the individual, the richness of the soil and the climate; during these years the plant is storing in its fleshy leaves the nourishment required for the effort of flowering. During the very rapid development of the immense peduncle, or flowering stalk, there is a rush of sap to the base of the young flower stalk; by removing this large bud just as it is ready to emerge and by scooping out a cavity in the heart of the plant, a large quantity of sweet sap is obtained; and this *aguamiel,* removed, carried in pigskin bottles to the central repository, undergoes two kinds of fermentation, and when it has become thick, milky and more or less ropy (the sugars then being changed into alcohol) it is marketed as *pulque* (*q.v.*), the national drink of Mexico; notwithstanding its objectionable odor and consistency it is by some thought a wholesome and nourishing drink, and many train-loads are brought daily to Mexico City from the vast *pulque* plantations in the surrounding region. By distillation of *pulque fuerte,* or completely fermented juice, a very strong liquor, *mescal,* is obtained.




LONGITUDINAL SECTION FROM BAILLON, "HISTOIRE DES PLANTES"

CENTURY PLANT (A. AMERICANA), SO NAMED BECAUSE IT WAS SUPPOSED TO BLOSSOM ONLY WHEN 100 YEARS OLD AND THEN DIE

Showing long flower stem and rosette of spiny leaves; vertical section and single flower enlarged

The leaves of several species yield commercial fibres: *A. rigida elongata* or *A. fourcroydes* is the henequen, or Yucatan sisal, formerly the principal sisal fibre (*q.v.*) *Agave sisalana* is the Bahama sisal, the cultivation of which is expanding greatly in East Africa and Haiti.

*A. cantula* is the Maguey, or Philippine sisal.

*A. zapupe* is the Mexican *Zapupe* fibre.

*A. americana* produces one of the *Pita* fibres, now grown in southern Europe and parts of the West Indies as well as in Mexico.

*A. neglecta* is the Florida sisal, one of the largest species, the flower-stalk of which may exceed 42 feet in height.

The firm white pith of the interior of the flowering stem of any of these species, when dried and cut in slices has a variety of uses—as natural razor-strops, as lining of insect-boxes, insulating material, etc. The gummy, soapy juice expressed from the leaves will lather like soap and may be used as a detergent where alkali would be injurious. The thick reddish roots of various species are reputed to have medicinal properties. The concentrated sap exuded into the scooped-out central bud cavity is also used as a medicine and is a source of agavose ($C_{12}H_{22}O_{11}$), one of the rare sugars. In the Madras Presidency the plant is widely used for hedges along railroads. *Agave americana* was introduced into Europe about the middle of the 16th century and is now extensively cultivated for its handsome appearance; in the variegated forms the leaf has a white or yellow marginal or central stripe from base to apex. As the leaves unfold from the centre of the rosette the impression of the marginal spines is very conspicuous on the still erect younger leaves.

**AGDE,** a town of south France, in the department of Hérault, 2½m. from the mouth of the Hérault, and 32m. S.W. of Montpellier on the Southern railway. Pop. (1936), 8,546. It lies at the foot of an extinct volcano, the Montagne St. Loup, and is surnamed "La Ville Noire" from the dark volcanic basalt of which it is built. Agde is said to have been founded as a port by Phocaeans under the name of *Agathe* It was the seat of a bishop from 400 to 1790. Overlooking the river is the old Cathedral of St. Étienne, a grim fortress-like structure of the 12th century. The machicolations of the parapet are said to be the oldest existing instance of the kind. The *Canal du Midi,* uniting the Garonne with the Mediterranean, passes under the town walls. The maritime commerce of the town has declined, because Cette is near and the Hérault shallow, but the fishing industry is still alive. The town has a tribunal of commerce.

SYNOD OF AGDE (*Concilium Agathense*).—The 47 genuine canons of the synod (Sept. 11, 506), dealt with discipline, church life, alienation of ecclesiastical property and treatment of Jews. While favouring sacerdotal celibacy the council laid rather rigid restrictions on monasticism. It commanded that the laity communicate at Christmas, Easter and Whitsuntide. The canons of Agde are based in part on earlier Gallic, African and Spanish legislation; and some of them were re-enacted by later councils.

**AGE.** The subject of the duration of human and animal life does not fall within the scope of this article, and the reader is referred to LONGEVITY. But the word "age" has been used by physiologists to express certain natural divisions in human development and decay. These are usually regarded as numbering five, viz., *infancy,* lasting to the seventh year; *childhood* to the 14th; *youth* to the 21st; *adult life* till 50; and *old age.*

The division of human life into periods for legal purposes is naturally more sharp and definite than it can be for physiological purposes. In Roman law the legal divisions were (1) *infantia* lasting till the close of the seventh year; (2) the period between *infantia* and *pubertas,* males becoming *puberes* at 14 and females at 12; (3) *adolescentia,* the period between puberty and majority; and (4) the period after the 25th year, when males become *majores.* By English law, life is divided into two main periods—*infancy,* which lasts in both sexes until the 21st year, and manhood or womanhood. The period of infancy, again, is divided into several stages, marked by the growing development both of rights and obligations. Thus at 12 years of age a male may take the oath of allegiance; at 14 both sexes are held to have arrived at years of discretion, and may therefore choose guardians, give evidence, and consent or disagree to a marriage. A female has the last privilege from the 12th year, but the marriage cannot be celebrated until the majority of the parties without the consent of parents or guardians. At 21 both males and females obtain their full legal rights and become liable to all legal obligations Thus both sexes may enter parliament and be called to the bar, upon attaining majority. In the Church of England, however, a candidate for deacon's orders must be 23 (in the Roman Catholic Church, 22), and for priest's orders 24 years of age; and no clergyman is eligible for a bishopric under 30. In Scotland infancy is not a legal term. The time previous to majority, which, as in England, is reached by both sexes at 21, is divided into two stages: *pupilage* lasts until the attainment of puberty, which the law fixes at 14 in males and 12 in females; *minority* lasts from these ages respectively until 21. *Minority* obviously corresponds in some degree to the English *years of discretion,* but a Scottish minor has more personal rights than an English infant in the last stage of his infancy, *e.g.,* he may dispose by will of movable property, make contracts, including that of marriage, carry on trade and become liable to be declared a bankrupt. Throughout the British Empire the age of majority is usually 21, but the

nubile age is 20 in the Channel Islands; 18 in New Brunswick and Ontario; 18 for females in the North-West Territories and 15 for native females in Fiji. In Belgium and France the age of majority is 21, and the nubile age 18 for males and 15 for females, but marriage cannot be contracted without the consent of the parents or guardians if the parties are under 25. The age of majority is in Argentina 22; in Chile, Spain and Austria 24; in China 20; in Brazil, Denmark, Holland, Germany, Greece, Italy, Mexico, Norway, Peru, the Philippines, Poland, Portugal, Rumania, Sweden, Switzerland and Tunis, 21. In Denmark the nubile age is 18 for males and 16 for females; in Germany 20 for males and 16 for females, subject to the consent of the parents or guardians, and without such consent the males must be 25 and the females 24. But a person of 18 may be declared of full age by a competent court. In Spain majority is reached at 23; the nubile age is 18 for males and 16 for females. In Greece the nubile age is 16 for males and 14 for females; in Holland 18 for males and 16 for females; in Italy 18 for males and 15 for females; in Switzerland 21 for males and 19 for females, but the canton authorities may in extraordinary cases reduce these figures to 19 and 18 respectively. Marriage by minors is subject to the consent of their parents or guardians.

By the constitution of the United States the President must be not less than 35; a senator not less than 30, and a representative not less than 25 years of age. The age of majority, as a rule, is 21 for both males and females, but in Arkansas, California, Colorado, Dakota, Idaho, Illinois, Iowa, Kansas, Maryland, Minnesota, Missouri, Nebraska, Nevada, Ohio, Oregon, Vermont and Washington females attain majority at 18. In Maryland, Oregon, and Texas a female attains majority upon marriage. In Iowa, Texas and Louisiana both males and females attain majority upon marriage, and in Washington a female minor married to a male of age is regarded as herself of full age. (H. H. L. B.)

**AGE GRADES** means a system of compulsory association or classification by age and sex, whereby groups of coevals are admitted by a series of initiatory rites of varying complexity, including generally the payment of a due, into a tribal association with definite functions both within the age group itself and in relation to the tribe as a whole, promotion to higher degrees, where such exist, being at regular intervals jointly compulsory on all the individuals comprising a group.

Though superficially resembling secret societies (*q.v.*), and though the ritual of initiation and subsequent ceremonies and esoteric beliefs are secret where a knowledge of them is confined to those who have been initiated and is moreover commensurate with the degree of their initiation, age grades are differentiated from other forms of association, including secret societies, by the following distinctive features: (1) Admission depends primarily on age and is associated with puberty rites. (2) Every member of the tribe must be affiliated to the system at the proper age. (3) There is no individual admission, but groups of coevals are jointly initiated. (4) Promotion to higher degrees of initiation is similarly compulsory and automatic with the passage of years, even when fees have to be paid or further rites have to be undergone. (5) The system is strictly unilateral, confined to males, though a corresponding institution for females may exist but, where it exists, functions independently. (6) The system is democratic.

Primitive societies are conspicuously divided vertically into families and clans and are horizontally stratified by a variety of associations: religious, occupational, political, social, and so on. Distinction by age and sex cuts across the bonds of consanguinity and creates a new orientation of social activity. Mere classification by age or sex, however, does not of itself indicate an age grade, for a variety of other factors is involved. A physiological classification of a tribe into boys, youths, adults and old men, with their feminine counterparts, stereotyped by custom into a conventional nomenclature, often lacks the distinctive sociological features of an age grade: just as we find puberty rites in almost all primitive societies, whereas age grades, though associated with puberty ceremonies and retaining them as an essential element in the complex, are comparatively rare.

Many of the institutions which are reported from different parts of the world, though analogous to age grades, differ in one or more essential factors and are therefore to be excluded from this survey. Such institutions are found in Australia, New Guinea, in the Banks Islands, among some of the Naga tribes of Assam, and in certain American Indian societies. The *aluzhi* of the Sema Naga, for instance, are working gangs, with few sociological obligations on the members. They are bisexual, coevality is not essential, and members can be ejected from the group. When clan feeling runs high in a community the *aluzhi* groups break up, indicating that the lateral stratification of society has not the same validity as the vertical. In short, all the essentials of an age grade are lacking. The Kimta of Bartle Bay, though it has a superficial resemblance to an age grade, admits of individual members being degraded or promoted to lower or higher degrees, thus invalidating the paramount theory of group-solidarity. Again, though age is the theoretical basis of Banks Islands' societies it is in fact an unimportant factor, and at every stage of initiation except perhaps the lowest, increasingly prohibitive admission fees have resulted in "a commensality of varying years and vastly different social prospects." This is no less true of America and even in the military societies of the Hidatsa, which approach nearest to the definition, the bases of membership are purchase and age, and group-promotion is not automatic but depends on purchase.

Only in Africa, and within a limited area, is the true age grade system found functioning as a sociological element in tribal life and of the utmost importance. Nowhere do we find age grades and secret societies concurrently, for secret societies are associated with the evolution of monarchies and powerful aristocracies, which they both limit and reinforce, whereas age grades are democratic and are incompatible with any system of centralized and individual authority. This accounts for the absence of age grades in Bantu societies generally, with the exception of a few Bantu tribes of the eastern group, such as the Akikuyu, Akamba, Giriyama and Chaga, who have been considerably influenced by neighbouring Hamites and have a culture which is no longer characteristically Bantu. Similarly, on the west coast of Africa we find a system analogous to age grades among the Kru, where secret societies are almost negligible and are subordinate to the Sedibo class of age grades, which comprises the tribal legislature and executive.

The age grade is the distinctive feature of Hamitic culture and is found in all the tribes of East Africa which belong to the Hamitic or Nilo-Hamitic groups, including the Nilotic Lango. The Galla, with their very complex system, are the centre and source of this culture, and from them it has permeated all the Nilo-Hamitic tribes which cluster round them, the Masai and the Nandi, the Topotha, the Turkana and the Didinga.

There are naturally modifications and variations in the system adapted to the cultural requirements of each tribe, but the essentials are basically the same. At the puberty rites (which recur at regular intervals) a group of boys is initiated and they are thus aggregated into tribal, as opposed to family and clan, life. Henceforth they are no longer classed with the women but find themselves in a group of coevals, with a variety of lifelong privileges and obligations towards each other. Hospitality within the age group is compulsory, and at a later stage, when the members are permitted to marry, this often includes access to the wives of age-mates. The group on the formal side is distinguished by a variety of emblems, such as shield designs, bodily markings and ornaments, and a special name assumed jointly and individually at initiation by every member of the group and retained throughout life. Promotion to higher degrees of the system is automatic after a given number of years, and each degree has its own special functions, appropriate ceremonials and emblems, and often a particular diet and distinctive tabus; the warrior degree, for instance, being generally prohibited smoking, beer and marriage. The final degree usually enables the group-members to retire from the active life of the tribe to the more passive rôle of an elder.

The essence of the system is the corporate unity of the group, which moves from degree to degree as a single entity. This unity

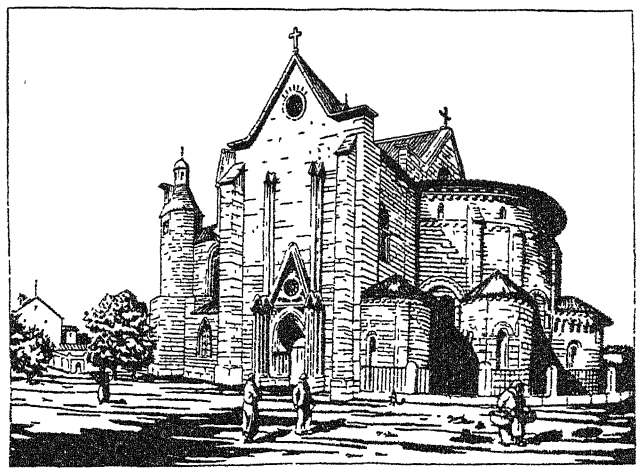
makes the group so significant an element in tribal culture. At the puberty schools and at subsequent initiations on promotion to higher degrees the age groups receive a systematic education which, as among the Galla, may extend over 32 years. Candidates are instructed in the duties of citizenship, in tribal history and tradition, ethics, the law, hunting, war, religion, husbandry, medicine, sex, in short in every aspect of individual and communal life. They are [illegible] by hardships and privations and trained to endure all manner of physical discomforts and dangers, in order to be the better able to perform the rôle traditionally allotted to the group at each degree in its initiation. Among the Galla the system provides for the government of the country by each group in turn during its last eight years of active existence. The Masai and the majority of kindred tribes use the system for military and governmental purposes, and the Lango thanks to a changed environment, have endowed their age grade system with functions which are almost exclusively religious. Finally, the system as a whole makes for greater tribal unity by cutting across the narrow limits of the family and the clan, by giving every individual an interest in tribal, rather than parochial, concerns, and by making every individual feel that with his group he is for the time the repository of tradition and the custodian of his tribe, both heir to the past and the pledge of posterity.

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**AGELADAS** or (as the name is spelled in an inscription) HAGELAIDAS, a great Argive sculptor who flourished in the latter part of the 6th and the early part of the 5th century B.C. Ageladas was said to have been the teacher of Myron, Pheidias, and Polycleitus; this tradition is a testimony to his wide fame, though historically doubtful.

**AGEMA,** the name of the bodyguard of Alexander of Macedon. It was drawn from the distinguished corps of "shield bearers" or esquires (ὑπασπισταί). While in Bactria, Alexander reorganized the agema and included some Persians.

**AGEN,** south-west France, capital of the department of Lot-et-Garonne, 84 mi. S.E. of Bordeaux by the Southern railway.



THE CATHEDRAL OF ST. CAPRAIS, AGEN, DATING FROM THE 12TH CENTURY, IS MODERN COMPARED WITH THE TOWN ITSELF WHICH WAS A CELTIC STRONGHOLD AND CONSIDERED OLD IN ROMAN TIMES

Pop. (1946) 33,397. It is skirted on the west by the Garonne, here crossed by a stone bridge and by a canal-bridge.

Agen (*Aginnum*) was the capital of the Nitiobroges, and extensive Roman ruins have been discovered. Later it was the capital of the Agenais. Its bishopric was founded in the 4th century. Agen frequently changed hands during the Albigensian wars, and at their close a tribunal of inquisition was established here. In the religious wars of the 16th century Agen took the Catholic side and joined the League in 1589. The cathedral of St. Caprais has an apse of the 12th century and three [illegible]: the rest dates from the 12th–16th centuries, the tow[illegible] the south façade is modern. The church of the Jacobins is a 13th century brick building. The prefecture (18th century) was once the bishop's palace. The *hôtel de ville* occupies the former *Hôtel du Presidial,* an obsolete tribunal, and contains the municipal library. Two houses of the 16th century, the *Hôtel d'Estrades* and the *Hôtel de Vaurs,* are used as the museum. Through its excellent water communication, Agen affords an outlet for the agricultural produce of a rich district, and forms an *entrepôt* between Bordeaux and Toulouse, dealing in poultry, prunes (*pruneaux d'Agen*), and other fruit, wine, vegetables and cattle. Flour, dried plums, *pâté de foie gras* and other delicacies, manures, drugs, woven goods and tiles are made. Agen is the seat of a bishop. It has a court of appeal and a court of assizes, tribunals of first instance and of commerce and a chamber of commerce.

**AGENAIS** or AGENOIS, a former province of France, of which Agen was the centre and to which the modern department of Lot-et-Garonne nearly corresponds. In ancient Gaul it was the country of the Nitiobriges, then a Gallo-Roman *civitas* (the 4th-century *Civitas Agennensium*) whose limits became those of the diocese of Agen. Having in general shared the fortunes of Aquitaine during the Merovingian and Carolingian periods, Agenais next became an hereditary countship; but from the middle of the 10th century it was part of the demesne of the counts of Bordeaux, dukes of Gascony; consequently in 1032 it fell to the counts of Poitiers when they inherited Gascony. The marriage of Eleanor of Aquitaine with Henry Plantagenet in 1152 brought it under England; but when Richard I married his sister Joan to Raymund VI, count of Toulouse, in 1196 Agenais formed part of her dowry, although remaining in the vassalage of Gascony. In 1249, with the other estates of Raymund VII, it lapsed to Alphonse of Poitiers, his son-in-law and the brother of Louis IX; but in 1259, by the treaty of Paris, Louis IX promised that if Alphonse and his wife Jeanne died childless their demesnes in Agenais would return to the king of England. When Jeanne did die childless in 1271, Philip III had the country occupied; but Edward I protested and it was restored to England by the treaty of Amiens in 1279. Yet the king of France claimed direct overlordship on a number of places, and the dispute over one of them (Saint-Sardos) brought a renewal of the war between France and England under Charles IV. During the Hundred Years' War Agenais was several times taken and retaken, until the final retreat of the English in 1441 left it under the French. It was for a time an appanage of Louis XI's brother Charles of Berry (1469–1472) and of Margaret of Valois (first wife of Henry IV), on whose death in 1615 it was reunited to the crown. Thenceforth Agenais was no more than an administration term. At the end of the *ancien régime* Agenais was a *sénéchaussée,* incorporated in the *gouvernement* of Guienne and the *intendance* of Bordeaux. Since the late middle ages at least, Agenais has been a rich agricultural country, subject however to alternating phases of depopulation and immigration.

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**AGENT:** *see* PRINCIPAL AND AGENT.

**AGENT-GENERAL,** the term given to the representatives in England of certain of the self-governing British colonies. They are appointed, and their expenses and salaries provided, by the governments of the colonies they represent. Their duties are to look after the political and economic interests of their colonies in London, to assist in all financial and commercial matters in which their colonies may be concerned, and to make known the products of their colonies. Those colonies which are not under responsible government are represented in London by crown agents.

**AGENTS IN BUSINESS.** An agent in the most general sense is any person who transacts business for another without being a direct employee, and in the majority of cases his function is to assist a principal in the purchase, sale or distribution of goods for a remuneration which usually takes the form of

a commission on the price obtained It is a term very loosely applied. Assistance may be rendered to principals irrespective of the commercial undertakings in which they are engaged Consignment agents and credit inquiry agents are examples of this category as compared with factors or brokers who operate continuously for principals in particular industries and with manufacturers' agents who are more particularly associated with special lines of goods There is an intermediate class of agents not directly concerned with the sale of goods and therefore not remunerated on a commission basis but who are of vital importance to the producer and manufacturer, the two most important being (*a*) advertising agents, whose function is to promote the commercial activity which is the beginning and the end of every undertaking, and (*b*) patent agents whose services are needed in most cases before manufacture can be commenced and who are also in a position to introduce their clients to the agents best qualified to market the product.

**Manufacturers' Agents.**—In the early stages of a manufacturing business when problems of production absorb the energies of the proprietor he is frequently glad to be relieved of all marketing problems by handing over the entire output to be disposed of by one or more manufacturers' agents on the commission basis which maintains this important section of the trading community The method usually adopted is to sell by sample, the principal making arrangements for delivery and collecting accounts. But some manufacturers' agents operate on a much larger scale, especially in the textile industry, maintaining warehouses, stock rooms and administrative departments. The intimate knowledge possessed by the manufacturers' agent of the various requirements of the public is of great value to the principal; so much is this the case that the advisory services of the agent may be vital to the success of the undertaking and his influence on the policy of the business as powerful as if he were a partner. An agent of this standing is invariably consulted before new lines are introduced and he periodically brings forward suggestions calculated to increase trade which will bring him increased commission and the principal increased turnover.

**Factors.**—The tendency of modern business is to shorten the chain between producer and consumer, the chief forces operating being the extension of advertising in all directions, the growth of consumer co-operation and the increase in competition which leads to producer co-operation and the formation of trusts or buying groups. The effect on the manufacturers' agent is for him to accept greater personal responsibilities and virtually to take over the functions of a factor who, while his remuneration is also on a commission basis, is much more independent of his principal than is the manufacturers' agent. Invariably the factor has possession of the goods of the principal; he is generally able to get a better price and sells the goods as though they were his own, leaving the buyer no clue to identity. He also frequently acts as banker for his principal, owing to the necessity of his carrying a large stock for disposal in anticipation of increased demand. It is in his interests to induce the manufacturer to produce on a larger scale at a lower cost than if the production were small, and this is done by his relieving the manufacturer of the necessity of recouping the expenditure of production with a quick sale. The factor is a large-scale operator in a number of industries, produce, textile, grain, hide, etc., and like the manufacturers' agent is continually exposed to the pressure of the forces making for a shorter chain between producer and consumer. The tendency is for him to discharge other marketing functions, to buy manufacturing businesses and do the work of a wholesale merchant.

**Brokers.**—A broker is an intermediary whose function is simply to buy or sell on behalf of a client, and who does not have possession of the goods dealt with. He is present at all exchanges where produce is disposed of and business arranged. He has a specialized knowledge of particular classes of goods, their sources of supply and the avenues of marketing. His duties are of a personal character, only a small establishment being required as his business is carried on by negotiation at the exchange and in the offices of clients. In the produce market brokers are indispensable—they study the crop reports, watch cargoes, take samples, collect statistics and furnish market reports. Pressure of competition and the shortening of the producer-consumer chain impels the broker to buy and sell on his own account.

(*See* ADVERTISING AGENT; BROKER.) (A. B. C.)

**AGENTS OF PRODUCTION**, in economics, a term used to describe the factors which combine in the production of wealth, as land, labour (*qq.v.*), capital and organization. (*See* AGRICULTURAL ECONOMICS; CAPITAL AND INTEREST; ECONOMICS; ENTREPRENEUR.)

**AGESANDER**, a Rhodian sculptor who is mentioned by Pliny (*Nat. Hist.*, xxxvi, 37) as author (with Polydorus and Athenodorus) of the group of the Laocoön Inscriptions found at Lindus in Rhodes date Agesander and Athenodorus to the period 42–21 B.C.

**AGESILAUS II,** king of Sparta, of the Eurypontid family, was the son of Archidamus II and Eupolia, and the younger stepbrother of Agis, whom he succeeded about 401 B.C. Agis had, indeed, a son Leotychides, but he was set aside as illegitimate, current rumour representing him as the son of Alcibiades. Agesilaus' success was largely caused by Lysander, who hoped to find in him a willing tool for the furtherance of his political designs. In this hope, however, he was disappointed, and the increasing power of Agesilaus soon led to Lysander's downfall In 396 Agesilaus was sent to Asia with a force of 2,000 neodamodes (enfranchised helots) and 6,000 allies to secure the Greek cities against a Persian attack. On the eve of sailing from Aulis he attempted to offer a sacrifice, as Agamemnon had done before the Trojan expedition, but the Thebans intervened to prevent it, an insult for which he never forgave them. On his arrival at Ephesus a three-months' truce was concluded with Tissaphernes, the satrap of Lydia and Caria, but negotiations conducted during that time proved fruitless, and on its termination Agesilaus raided Phrygia, where he easily won immense booty since Tissaphernes had concentrated his troops in Caria. After spending the winter in organizing a cavalry force, he made a successful incursion into Lydia in the spring of 395. Tithraustes was thereupon sent to replace Tissaphernes, who paid with his life for his continued failure

An armistice was concluded between Tithraustes and Agesilaus, who left the southern satrapy and again invaded Phrygia, which he ravaged until the following spring.

He then came to an agreement with the satrap Pharnabazus and once more turned southward. It was said that he was planning a campaign in the interior, or even an attack on Artaxerxes himself, when he was recalled to Greece because of the war between Sparta and the combined forces of Athens, Thebes, Corinth, Argos and several minor states. A rapid march through Thrace and Macedonia brought him to Thessaly, where he repulsed the Thessalian cavalry which tried to impede him. Reinforced by Phocian and Orchomenian troops and a Spartan army, he met the confederate forces at Coronea in Boeotia, and in a hotly contested battle was technically victorious, but the success was a barren one and he had to retire by way of Delphi to the Peloponnese. Shortly before this battle the Spartan navy, of which he had received the supreme command, was totally defeated off Cnidus by a powerful Persian fleet under Conon and Pharnabazus.

Agesilaus took a leading part in the Corinthian War, making successful expeditions into Corinthian territory, and capturing Lechaeum. But the destruction of a *mora* by Iphicrates neutralized these successes, and Agesilaus returned to Sparta. In 387 the Peace of Antalcidas (*q.v.*), which was warmly supported by Agesilaus, put an end to hostilities. When war broke out afresh with Thebes the king twice invaded Boeotia (378, 377) and it was on his advice that Cleombrotus marched against Thebes in 371. Cleombrotus was defeated at Leuctra and the Spartan supremacy overthrown. In 370 Agesilaus tried to restore Spartan prestige by invading Mantinean territory and his heroism saved Sparta when Epaminondas penetrated Laconia that same year, and again in 362 when he all but succeeded in seizing the city. Sparta stood aloof from the general peace of 362 hoping to recover its supremacy. In order to gain money for the war Agesilaus had supported the revolted satraps; in 361 he went to Egypt at the head of a mercenary force to aid Tachos against

Persia, and died, at the age of 84, on his way home.

Agesilaus was a small man, somewhat lame from birth. He was a successful leader in guerilla warfare, alert and quick, yet cautious, and his bravery was unquestioned. He lived in the most frugal style and enriched the state and his friends with the spoils of his campaigns, returning himself as poor as he had set forth He was sincerely patriotic, but the worst trait in his character was his implacable hatred of Thebes, which led to the battle of Leuctra and Sparta's fall from supremacy

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**AGGLOMERATE,** the term applied to coarse fragmental rocks produced by explosive volcanic eruptions, and consisting mainly of rounded or subangular bombs, at least partly plastic when erupted, that lie in a matrix of tuff and are found within or near volcanic pipes. Volcanic breccias differ from agglomerates in the angularity of the fragments, which are erupted in a solid condition. (H. Ws.)

**AGGLUTINATION,** a term used technically in philology for the method of word formation by which two significant words or roots are joined together in a single word to express a combination of the two meanings each of which retains its force (Lat *ad* and *glutinare,* lit. to fasten together with glue) This juxtaposition or conjoining of roots is characteristic of languages such as the Turkish and Japanese, which are therefore known as agglutinative, as opposed to others, known generically as inflexional, in which differences of termination or combinations in which all separate identity disappears are predominant.

The term was also formerly used by associationist philosophers for those mental associations which were regarded as peculiarly close. W. Wundt applies this term to those simplest cases of apperceptive synthesis in which the simpler ideas composing the complex idea retain their independence—as, for instance, in the idea expressed by "church-steeple." (X.)

In medicine, the holding together of wound edges as a part of the process of early healing is called agglutination, as is the clumping of bacteria, organisms or cells in some fluid medium either natural or artificial. It is believed to be caused by more or less specific substances called agglutinins. The reaction may be seen under a microscope or with the naked eye in some cases. This phenomenon is utilized to determine the existence of a disease such as typhoid fever and also to decide whether or not a specific blood is a safe one for transfusion. (F L. A.)

**AGGRAVATION** (Lat. *ad,* "increasing," *gravis,* "heavy"), the making anything graver or more serious; also used as synonymous with "irritation." In the canon law "aggravation" was a form of ecclesiastical censure, threatening excommunication after three disregarded admonitions.

**AGGREGATE,** a term used in building and construction to designate the material with which cement, lime, gypsum or other adhesive material, such as bitumen, is mixed to form a concrete or mortar (*q.v.*). The most common aggregates are sand, crushed or broken stone, gravel or pebbles, broken blast-furnace slag, boiler ashes or clinker, burned shale and burned clay. The purpose of the aggregate is to provide volume, freedom from change in volume, and resistance to wear or erosion and other desired physical properties, in the finished product.

Aggregates are divided into two general classes commonly known as fine aggregate and coarse aggregate. The fine aggregate is generally sand, crushed stone or crushed slag screenings; the coarse aggregate is gravel (pebbles), fragments of broken stone, slag and the other substances above mentioned. The dividing line between fine and coarse aggregate is usually a ¼-in. screen opening, sometimes a ⅛-in. opening. Aggregates are mixed with the cement or binding material in proportions varying from one part of cementing material to one part of fine aggregate for a "rich" mortar to one part of cement to nine or ten parts of mixed fine and coarse aggregates for a "lean" concrete. The theory upon which such mixtures are proportioned is that there shall be sufficient cementing material to coat all of the particles in the fine aggregate, and that there shall be sufficient mortar so produced to fill all the voids in the coarse aggregate. The ideal concrete would consist of closely packed fragments of crushed stone, slag or pebbles in which all the fragments are coated with mortar, and all the voids between the coarser fragments filled with mortar. Under actual conditions in construction work there is practically always an excess of mortar Nearly all natural sands require washing or rinsing to remove loam, clay, organic material, etc. A gradual variation in size from about 50 mesh (50 openings per linear inch) to ¼-in. mesh is desirable for the strongest mortar or concrete The preparation of commercial fine aggregate therefore often requires artificial grading or mixing of the various sizes. This is usually accomplished by hydraulic separation of the undesirable fine sizes, which usually are in excess. For coarse aggregate any hard, tough, durable rock may be crushed, screened and graded The common commercial sizes vary from ¼ in to 3½ in. in largest dimension The most desirable rocks for general construction purposes are basalt, commonly called trap, and fairly pure limestone. Such rocks are not only durable but fire-resisting. Specification requirements include cleanliness (maximum limits of extraneous impurities), limiting percentages of various sizes, soundness (freezing and thawing tests, for example), sometimes mineralogical composition (designed to ensure soundness).

In this age of concrete construction and road building the business of supplying aggregates for construction work has grown to large proportions. In the U S. alone production amounts to approximately 300,000,000 tons per annum, valued roughly at $300,000,000, requiring an investment of about $500,000,000 in washing, screening and crushing equipment and accessory machinery for mining and conveying the raw and finished materials.

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**AGGREGATES, THEORY OF.** An aggregate may be defined as a collection of objects of some kind or other. In mathematics the objects making up an aggregate are usually mental objects; *i.e.,* concepts or ideas. However, material objects may also be used to constitute an aggregate. Other synonyms for aggregate are: class, set, domain, totality. In this article these words will be used interchangeably. Writers on mathematics sometimes make special distinctions between them for special purposes.

The theory of aggregates was developed enthusiastically by Georg Cantor and other mathematicians in the latter part of the 19th century, but the uncritical use of its concepts and methods soon led to logical contradictions. Workers in mathematical logic made a variety of attempts to set up rules which would prevent these contradictions, but no general agreement as to a desirable method was reached. However, contradictions are not met in the uses to which the theory of classes is actually put in mathematics.

**Determination of an Aggregate.**—The fundamental relation in the theory of classes is that of class membership. This may be taken as an undefined relation, whose meaning is understood from the way in which it is used. The symbol $x \epsilon A$ is frequently used to state that an object $x$ is a member of a class $A$. A class is well-defined when a workable criterion is given for telling what objects are members of it. Thus, a class may be determined by a suitably stated property or a suitably worded "propositional form," or in some cases by simply pointing out its members. The class of all people who have blue eyes is not well-defined for mathematical purposes, first, because it may sometimes be difficult to determine whether a person's eyes are blue or gray, and second, because people are continually being born and dying. On the other hand, the class of all integers greater than 10 and less than 100 is a mathematically well-determined class.

**Operations on Aggregates.**—A class $A$ is said to be a subset of a class $B$ in case every member of $A$ is also a member of $B$. This relation of class inclusion is indicated by the notation $A \subset B$, which is read "$A$ is a subset of $B$," "$A$ is included in $B$," or "$A$ is contained in $B$." Let $U$ denote a fixed class, and denote sub-

classes of $U$ by the letters, $A, B, C, \ldots$. The fundamental operations on classes are: logical addition, logical multiplication and logical subtraction. The sum $A+B$ of two classes (also called the union of $A$ and $B$) is the class consisting of all the members of $A$ or $B$ or both. The product $AB$ of two classes (also called the intersection of $A$ and $B$) is the class consisting of all the objects which are simultaneously members of both $A$ and $B$. The difference $A-B$ consists of all the objects which are members of $A$ but not members of $B$. The special difference $U-B$ is called the complement of $B$, and denoted by $cB$. The operations of logical addition and logical multiplication may clearly be applied to any number of classes and even to an infinite collection of classes. In order that the operations of logical multiplication and logical subtraction may always be carried out, a special class, called the null class, and having no members, is introduced by agreement. If $A \subset B$, then $A-B$ is the null class. The null class behaves with respect to logical addition and multiplication much as 0 does in ordinary algebra. Logical addition and multiplication obey the associative, commutative and distributive laws of ordinary algebra, and also the new distributive law: $A+BC=(A+B)(A+C)$. But logical subtraction does not behave like ordinary subtraction, since $(A+B)-C$ is not always equal to $A+(B-C)$. Also $(A-B)(A-C)=A-(B+C)$. Another important operation on two classes $A$ and $B$ is the Cartesian product $A \times B$, which is defined as the aggregate of all pairs $(x, y)$ of which the first element $x$ is a member of $A$, and the second element $y$ is a member of $B$. This kind of product is named after the French mathematician René Descartes. In his analytic geometry the points of a plane are represented by pairs of numbers $(x, y)$, where the numbers $x$ and $y$ represent distances measured respectively along two intersecting lines in the plane. The Cartesian product is not commutative, but it is distributive with respect to logical addition, and also with respect to logical multiplication, that is, $(A+B)\times C=(A\times C)+(B\times C)$, $(AB)\times C=(A\times C)(B\times C)$.

**Finite and Infinite Aggregates.**—An important distinction is that between finite and infinite aggregates. This distinction is defined logically, by means of the notion of one-to-one correspondence. An aggregate $A$ is said to be in one-to-one correspondence with an aggregate $B$ when each element $a$ of $A$ is paired with one and only one element $b$ of $B$, and vice versa. If for every possible one-to-one correspondence between $A$ and a subset $B$ of $A$ it is true that $B$ is the whole of $A$, then $A$ is said to be finite. But if there is a one-to-one correspondence between $A$ and a proper part $B$ of $A$, then $A$ is said to be infinite. The size of aggregates is compared by means of this notion of one-to-one correspondence, and this leads to the notion of number (*q.v.*). The numbers associated with infinite classes by means of this notion of one-to-one correspondence are called transfinite cardinal numbers. (*See* also INFINITY AND THE INFINITE.) The numbers associated with finite classes are called natural numbers. If an aggregate $A$ can be put into one-to-one correspondence with the set of all the natural numbers, it is said to be countably infinite. The cardinal number of countably infinite aggregates is usually denoted by $\aleph_0$. It is the smallest infinite cardinal.

**Theory of Aggregates in Mathematics.**—The theory of aggregates is fundamental for all of mathematics. Many of the branches of mathematics are characterized to some extent by the special structure or properties assumed for the aggregates considered in them. For example, part of algebra is concerned with aggregates whose elements are numbers, and with the operations of addition, multiplication, etc., performed on those elements. Geometry is concerned with aggregates whose elements may be called points, and with operations of motion, projection, deformation, etc., and relations of congruence, distance, etc. Aggregates in geometry are frequently called point sets. (*See* TOPOLOGY; POINT SETS.)

One of the basic notions in mathematics is that of ordered aggregates. A class $A$ is said to be ordered if a relation of precedence is set up between pairs of elements of $A$, with the following properties: (1) if $x$ and $y$ are distinct elements of $A$, then $x<y$ (read "$x$ precedes $y$") or $y<x$; (2) if $x<y$ and $y<z$ then $x<z$; (3) no two of $x=y$, $x<y$, $y<x$ can hold simultaneously. In case the ordering in $A$ is such that every subclass $B$ of $A$ has a first element $x_0$, that is, $x_0$ precedes every other element of $B$, then $A$ is said to be well-ordered. Every ordering of a finite class is a well-ordering but this is no longer true for infinite classes. For example, the natural numbers in their usual order form a well-ordered class, but if the order is reversed it is no longer a well-ordering of the class.

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**AGGREGATION,** in physics, a collective term for the forms or states in which matter exists. Three primary "states of aggregation" are recognized—gaseous, liquid and solid. Generally, if a solid is heated to a certain temperature, it melts or fuses, assuming the liquid condition (*see* FUSION); if the heating is continued the liquid boils and becomes a vapour (*see* VAPORIZATION). On the other hand, if a gas is sufficiently cooled and compressed, it liquefies; this transition is treated theoretically in the article LIQUEFACTION OF GASES.

**AGGTELEK,** a village in northern Hungary in that portion of the county of Gömör that remained in 1918 within Hungarian rule. Although small (pop. 648), it is world-renowned for its remarkable limestone grotto, the Aggtelek or Baradla cavern, one of the largest of its kind in Europe. It is composed of a labyrinth of passages and halls of various sizes, the total length, including its ramifications, exceeding 5 mi. A stream traverses the caves, which are rich in fantastic stalactite forms.

**AGINCOURT** (AZINCOURT), a village of northern France in the department of Pas de Calais, 14 mi. N.W. of St. Pol by road, famous on account of the victory, on Oct. 25, 1415, of Henry V of England over the French. The battle was fought in the defile formed by the wood of Agincourt and that of Tramecourt, at the northern exit of which the army under Charles d'Albret, constable of France, had placed itself so as to bar the way against the English forces which, after the capture of Harfleur, had set out to march through Picardy to Calais. Torrential rains hindered the English in crossing the Somme, and the delay allowed the French to concentrate in overwhelming numbers—d'Albret, indeed, refused to avail himself of the offer of 6,000 crossbowmen of the Paris citizen militia. Worse still, the English became so short of supplies that had the French but been content to block the path without risking an attack, hunger would have brought them the victory. The night of Oct. 24 was spent by the two armies on the ground, and the English had but little shelter from the heavy rain. Early on the 25th, St. Crispin's day, Henry arrayed his little army (about 1,000 men-at-arms, 6,000 archers, and a few thousands of other foot). It is probable that the usual three "battles" were drawn up in line, each with its archers on the flanks and the dismounted men-at-arms in the centre; the archers being thrown forward in wedge-shaped salients, almost exactly as at Crécy (*q.v.*). The French, on the other hand, were drawn up in three lines, each line formed in deep masses. They were at least four times more numerous than the English, but restricted by the nature of the ground to the same narrow front 1,100 yd., they were unable to use their full weight (*cf.* Bannockburn); further, the deep mud prevented their artillery from taking part, and the crossbowmen were as usual relegated to the rear of the knights and men-at-arms. All were dismounted save a few knights and men-at-arms on the flanks, who were intended to charge the archers of the enemy. For three hours after sunrise there was no fighting; then Henry, finding that the French would not advance, moved his army farther into the defile. The archers fixed the pointed stakes, which they carried to ward off cavalry charges, and opened the engagement with flights of arrows. The chivalry of France, undisciplined and too obtuse to have assimilated the lesson of Crécy and Poitiers, was quickly stung into action, and the French mounted men charged, but their slow-moving horses made easy targets, soon shot down or driven back in confusion. The constable himself headed the leading line of dismounted men-at-arms; weighted with their armour, and sinking deep into the mud with every step, they yet reached and

engaged the English men-at-arms; for a time the fighting was severe. The thin line of the defenders was borne back and King Henry was almost beaten to the ground But at this moment the archers, taking their hatchets, swords or other weapons, penetrated the gaps in the now disordered French, who could not move to cope with their unarmoured assailants, and were slaughtered or taken prisoners to a man. The second line of the French came on, only to be engulfed in the *mêlée;* its leaders, like those of the first line, were killed or taken, and the commanders of the third sought and found their death in the battle, while their men rode off to safety The closing scene of the battle was a half-hearted attack made by a body of fugitives, which led merely to the slaughter of the French prisoners, which was ordered by Henry because he had not enough men both to guard them and to meet the attack The slaughter ceased when the assailants drew off The total loss of the English is stated at 13 men-at-arms (including the duke of York, grandson of Edward III.) and about 100 of the foot The French lost 5,000 of noble birth killed, including the constable, three dukes, five counts and 90 barons; 1,000 more were taken prisoners, amongst them the duke of Orleans (the Charles d'Orléans of literature). The moral lesson of the battle was the incapacity of a military caste to learn from experience, and to adapt their traditions intelligently to new needs. The material lesson was that armour stultified its own purpose when it fettered mobility The 15th-century soldier pinned his faith as obstinately on an increasing weight of armour as the 19th-century soldier on an increasing weight of numbers

*See* Sir Harris Nicolas, *Battle of Agincourt;* Fortescue, *History of the British Army,* vol. i.; and H. B. George, *Battles of English History;* Oman, *History of the Art of War in the Middle Ages,* vol. ii. 379–386.

**AGIO,** a term used in commerce in three connections.

(a) The variations from fixed pars or rates of exchange in the currencies of different countries For example, in most of the gold-standard countries, the standard coin is kept up to a uniform point of fineness, and so bears a constant relation to coins of other countries in a similar condition. This is what is known as the mint par of exchange. The balance of trade between the various countries is the factor determining the rate of exchange Should the balance of trade be against England, money must be remitted to France as payment for the indebtedness. But owing to the cost for the transmission of specie there will be a demand for bills as a cheaper and more expeditious method of sending money, and it therefore will be necessary to pay a premium for it, called the agio.

(b) The term is also used to denote the difference in exchange between two currencies in the same country; where silver coinage is the legal tender, agio is sometimes allowed for payment in the more convenient form of gold, or where the paper currency of a country is reduced below the bullion which it professes to represent, an agio is payable on the appreciated currency.

(c) Lastly, in some states the coinage is so debased, owing to the wear of circulation, that the real is greatly reduced below the nominal value. Supposing that this reduction amounts to 5%, then if 100 sovereigns were offered as payment of a debt in England while such sovereigns were current there at their nominal value, they would be received as just payment; but if they were offered as payment of the same amount of debt in a foreign state, they would be received only at their intrinsic value of £95, the additional £5 constituting the agio. Where the state keeps its coinage up to a standard value no agio is required. (*See* BALANCE OF TRADE.)

**AGIRA** (formerly San Filippo d'Argirò), town in the province of Enna, Sicily, with a railway station 4½ mi. to the south; 35 mi. W. of Catania. Pop. (1901) 17,738; (1936) 14,411 (town), 15,350 (commune). *Agyrion,* an ancient Sicel city, was ruled by tyrants, one of whom, Agyris, was contemporary of Dionysius I., and with him successfully resisted the Carthaginians in 392 B.C. Agyrion was not colonized by the Greeks until Timoleon drove out the last tyrant in 339 B.C.

**AGIS,** the name of four Spartan kings:

(1) Son of Eurysthenes, founder of the royal house of the Agiadae (Pausanias iii 2. 1). His genealogy was traced back to Heracles (Herodotus vii. 204), and he belongs rather to mythology than to history. Tradition ascribed to him the capture of Helos, and the institution of the class of serfs called Helots (*q.v.*). *See* Ephorus ap Strabo, viii. p 365.

(2) AGIS I., son of Archidamus II., Eurypontid, succeeded his father, probably in 427 B.C., and from his first invasion of Attica in 425 down to the close of the Peloponnesian War was the chief leader of the Spartan operations on land After the conclusion of the peace of Nicias (421 B.C.) he marched against the Argives in defence of Epidaurus, and after skilful manoeuvring surrounded the Argive army, and seemed to have victory within his grasp when he unaccountably concluded a four months' truce and withdrew his forces The Spartans were indignant, and when the Argives and their allies broke the truce Agis escaped having his house razed and a fine of 100,000 drachmae imposed only by promising to atone for his error by a signal victory This promise he fulfilled by routing the forces of the Argive confederacy at the battle of Mantinea (418) In the winter 417–416 a further expedition to Argos resulted in the destruction of the half-finished Long Walls and the capture of Hysiae. In 413, on the suggestion of Alcibiades, he fortified Decelea in Attica, where he remained directing operations until, after the battle of Aegospotami (405), he took the leading part in the blockade of Athens, which was ended in the spring of 404 by the surrender of the city Subsequently he invaded and ravaged Elis He fell ill on his return from Delphi, where he had gone to dedicate a tithe of the spoils, and died at Sparta, probably in 401.

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(3) AGIS II., son of Archidamus III., of the Eurypontid line. succeeded his father in 338 B.C., on the very day of the battle of Chaeronea. During Alexander's Asiatic campaign he revolted against Macedonia (333 B.C.) and, with the aid of Persian money and ships and a force of 8,000 Greek mercenaries, gained considerable successes in Crete. In the Peloponnese he routed a force under Corragus and, although Athens held aloof, he was joined by Elis, Achaea (except Pellene) and Arcadia, with the exception of Megalopolis, which the allies besieged. Antipater marched rapidly to its relief at the head of a large army, and the allied force was defeated after a desperate struggle (331) and Agis was slain.

BIBLIOGRAPHY.—*See* Pausanias iii. 10 5; Diodorus xvii. 48, 62, 63; Justin xii. 1, Quintus Curtius iv., 1, 39, vi., 1; Arrian, *Anabasis,* ii. 13.

(4) AGIS III., son of Eudamidas II., of the Eurypontid family, succeeded his father, probably in 245 B.C., in his 20th year at a time when the unequal distribution of land and wealth and the diminution in the number of full citizens threatened to ruin Sparta. He determined to restore the traditional institutions of Lycurgus. Lysander as ephor proposed on behalf of Agis that all debts should be cancelled and that Laconia should be divided into 19,500 lots, of which 4,500 should be given to Spartiates, whose number was to be recruited from the best of the perioeci and foreigners, and the remaining 15,000 to perioeci who could bear arms The abolition of debts was carried into effect, but the land distribution was put off on various pretexts by Agesilaus, the king's uncle, who wished to preserve his estates. At this point Aratus appealed to Sparta to help the Achaeans in repelling an expected Aetolian attack, and Agis was sent to the Isthmus at the head of an army. During his absence his enemies gained the upper hand, and on his return Agis, after a mock trial, was strangled in prison, his mother and grandmother sharing the same fate (241).

*See* Plutarch's biography. Pausanias' accounts (ii. 8. 5, vii. 7. 3, viii. 10. 5-8, 27. 13) of his attack on Megalopolis, his seizure of Pellene and his death at Mantinea fighting against the Arcadians. Achaeans and Sicyonians are without foundation (J. C. F. Manso. *Sparta.* iii. 2. 123–127, 1800–05). *See* also Manso, *op. cit* iii. 1. 276–302; B. Niese, *Geschichte der griechischen und makedonischen Staaten,* ii. 299–303 (1884).

**AGISTMENT.** To "agist" is, in law, to take cattle to graze, for a remuneration. The word is derived through O. Fr. from Lat. *iacere,* to lie. "Agistment," in the first instance, referred

more particularly to the proceeds of pasturage in the king's forests, but now means either (*a*) the contract for taking in and feeding horses or other cattle on pasture-land, for the consideration of a weekly payment of money, or (*b*) the profit derived from such pasturing. Agistment is a contract of bailment, and the bailee is bound to take reasonable care of the animals entrusted to him; he is responsible for damages and injury which result from ordinary casualties, if it be proved that such might have been prevented by the exercise of reasonable care.

There is no lien on the cattle for the price of the agistment, unless by express agreement. Under the Agricultural Holdings Act, 1883, agisted cattle cannot be distrained on for rent if there be other sufficient distress to be found, and if such other distress be not found, and the cattle be distrained, the owner may redeem them on paying the price of their agistment.

**AGITATION, THERMAL,** the motion of the molecules, within a body, which they possess by virtue of their absolute temperature. (*See* KINETIC THEORY OF MATTER; THERMODYNAMICS.)

**AGITATO** (Ital.), a musical term implying that the composition or passage so marked is to be played in a restless, agitated manner, a rapid *tempo* being usually indicated at the same time by the accompanying time-direction, *e.g*, *presto agitato.*

**AGITATORS** or ADJUTATORS, the name given to representatives elected in 1647 by the different regiments of the English parliamentary army. Early in 1647 the Long Parliament wished either to disband many of the regiments or to send them to Ireland. The soldiers, whose pay was largely in arrear, refused to accept either alternative, and eight of the cavalry regiments elected agitators, called at first commissioners, who laid their grievances before the three generals, and whose letter was read in the House of Commons on April 30, 1647. The other regiments followed the example of the cavalry, and after a temporary conciliation Parliament decided to disband the army on June 1. The agitators determined to resist; a mutiny occurred in one regiment and the attempt at disbandment collapsed. There followed the seizure of the king by Cornet Joyce, Cromwell's definite adherence to the policy of the army, the signing of the manifestos, a *Humble Representation* and a *Solemn Engagement,* and the establishment of the army council composed of officers and agitators. The agitators finally demanded a march towards London and the "purging" of the House of Commons. Subsequent events are part of the general history of England. Gradually the agitators ceased to exist, but many of their ideas were adopted by the Levellers (*q.v.*), who may perhaps be regarded as their successors.

*See* S. R. Gardiner, *History of the Great Civil War,* vols. iii. and iv. (1905).

**AGNANO, LAGO DI,** a crater lake, 5 m. W. of Naples, Italy; 4 m. in circumference, not mentioned in antiquity, probably formed in the Middle Ages, drained in 1866. It has a large modern thermal establishment with springs, natural sulphurous vapour baths and a grotto with constant exudation of warm carbonic-acid gas from the floor. There are extensive Roman remains (V. Macchioro, *Monumenti dei Lincei,* xxi. p. 225. *sqq.*, 1911). On the north side of the crater is a racecourse.

**AGNATES,** in Roman law, persons related through males only, as opposed to cognates. Agnation was founded on the idea of the family held together by the *patria potestas; cognatio* involves simply the modern idea of kindred.

**AGNES, SAINT,** a virgin martyr of the Catholic Church. The legend of St. Agnes is that she was a Roman maid, by birth a Christian, who suffered martyrdom at the age of 13, during the reign of the emperor Diocletian, on Jan 21, 304. The prefect Sempronius wished her to marry his son, and on her refusal condemned her to be outraged before her execution, but her honour was miraculously preserved. When led out to die she was tied to a stake, but the faggots would not burn, whereupon the officer in charge of the troops drew his sword and struck off her head. St Agnes is the patron saint of young girls, who, in rural districts, formerly indulged in all sorts of quaint country magic on St. Agnes' Eve (Jan. 20–21) with a view to discovering their future husbands. This superstition has been immortalized in Keats's poem, "The Eve of St. Agnes." St. Agnes's bones are supposed to rest in the church of her name at Rome, originally built by Constantine and restored by Pope Honorius in the 7th century. Here on her [illegible] 21) two lambs are specially blessed after pontifical high mass, and their wool is later woven into pallia.

**AGNESI, MARIA GAETANA** (1718–1799), Italian mathematician, linguist and philosopher, was born at Milan on May 16, 1718. She was an extremely precocious child. Her father was a professor of mathematics. Maria was only fourteen when she began to read a series of theses on philosophical questions to the learned men of Bologna who met regularly in her father's house (*see* Brosse, *Lettres sur l'Italie*). Her family resisted her early desire to enter a convent, but from her 20th year onward she lived in complete seclusion at home, devoting herself to the study of mathematics. When her father fell ill in 1752 Pope Benedict XIV. appointed her to his chair in the university. But on his death in 1754 she became directress of the Hospice Trivulzio of the Blue Nuns at Milan, and eventually joined the sisterhood. She died on Jan. 9, 1799. Her principal work is *Instituzioni analitiche ad uso della gioventu italiana* (2 vols., Milan 1748; French trans. of vol. i., Paris 1775; complete Eng. trans by John Colson, 1801).

Her sister, MARIA TERESA AGNESI (1724–80), composed several cantatas, two pianoforte concertos and five operas.

BIBLIOGRAPHY.—*See* Antonio Francesco Frisi, *Éloge historique de Mademoiselle Agnesi,* translated by Boulard (Paris, 1807); Milesi-Mojon, *Vita di M. G. Agnesi* (Milan, 1836); J. Boyer, "La Mathématicienne Agnesi," in the *Revue Catholique des revues francaises et étrangères* (Paris, 1897).

**AGNES OF MERAN** (d. 1201), queen of France, was the daughter of Bertold IV, duke of Meran in Tirol. In June 1196 she married Philip II, king of France, who had repudiated Ingeborg of Denmark in 1193. The pope espoused the cause of Ingeborg and eventually put the kingdom under an interdict, whereupon Philip pretended to agree to a separation from Agnes. In fact, he did not turn her away, and Ingeborg was imprisoned. Agnes died in Aug. 1201. The pope legitimized her children by Philip.

BIBLIOGRAPHY.—H. F. Delaborde *et al.* (eds.), *Recueil des actes de Philippe-Auguste,* vol. 2 (Paris, 1943); Duc de Lévis-Mirepoix, *Les Trois Femmes de Philippe-Auguste* (Paris, 1947); E. Rossier, *Sur les degrés du trône* (Lausanne, 1940)

**AGNEW, DAVID HAYES** (1818–1892), U.S. surgeon, was born in Lancaster county, Pa., on Nov. 24, 1818. He graduated from the University of Pennsylvania in 1838, and became a lecturer at the Philadelphia School of Anatomy. He was appointed surgeon at the Philadelphia hospital in 1854 and was the founder of its pathological museum. For 26 years (1863–89) he was connected with the medical faculty of the University of Pennsylvania.

From 1865 to 1884—except for a brief interval—Agnew was a surgeon at the Pennsylvania hospital. During the American Civil War he was consulting surgeon in the Mower Army hospital, near Philadelphia, and acquired considerable reputation for his operations in cases of gun-shot wounds. He attended as operating surgeon when Pres. James Garfield was fatally wounded by the bullet of an assassin in 1881.

Agnew was the author of several works, the most important being *The Principles and Practice of Surgery* (1878–83). He died in Philadelphia on March 22, 1892.

See *Surgery, Gynecology and Obstetrics,* pp. 295–299 (Feb. 1928).

**AGNI,** the fire god of the Hindus, second only to Indra in the Vedic mythology of India. He is invoked as "priest of sacrifice" in the first verse of the *Rig-Veda,* and, as messenger, between gods and men, sacrifices to him are upborne to the deities. On earth his parents are the two sticks of the fire drill, and every day he is reborn an immortal, living among men and supreme director of religious rites and duties. His form is however three-fold, fire on earth, lightning and the sun, and in art he is depicted as ruddy, with two faces, beneficent and malignant, three-legged (as in the fylfot. with seven arms). Later he was identified with Rūdra (*q.v.*). In modern India he has no professed sect, but is invoked in many ceremonies, and specially

affected by Agnihotri Brahmans who perform the "fire sacrifice" (*agnihotra*).

*See* A. A. Macdonell, *Vedic Mythology*, and F. Wast[illegible], *Epic Mythology* (1897 and 1915); J. N. Farquhar, [illegible] *Literature of India* and Mrs. Sinclair Stevenson, *Rites of the* [illegible] (1920).

**AGNI,** inhabitants of the Cold Coast and the French Ivory Coast between the Fanti territory and the Comoé river, south of the Abron (*q.v.*) people. They are of the same origin and have the same physical, social and linguistic characteristics as the Baule [illegible].

**AGNOETAE,** a minority of adherents to the Monophysite movement who (contrary to the general tendency of that form of Christology) maintained that Christ as man was ignorant of many things (Mark xiii. 32; Luke ii. 25) (Gr. ἀγνοέω, "be ignorant of"). The doctrine was condemned by Gregory the Great. (*See* MONOPHYSITES.)

**AGNOIOLOGY** (the theory of ignorance). The term was used by J. F. Ferrier (*Institutes of Metaphysics,* 1854) as a set-off to *Epistemology* (theory of knowledge). The theory was intended to counter the sceptical contention that Absolute Being may be beyond human knowledge, that the human mind may be condemned to remain ignorant of it. Ferrier's contention is that man cannot be said to be ignorant of what cannot be known; he can only be said to be ignorant when he does not know what can be known. On such lines Ferrier concludes that, since Absolute Being must either be something that we know or something that we are ignorant of, it cannot be subject only or object only but a synthesis of both.

**AGNOSTICISM.** Whereas scepticism, as a technical term in philosophy, denotes varying degrees of doubt as to whether some or all of the psychological processes, purporting to yield knowledge, really do so, agnosticism rather asserts that, of certain kinds of objects or facts, we possess assured knowledge, while as to certain other kinds of alleged existents we have, and can have, none. The kinds of alleged objects, knowledge as to which the agnostic believes to be impossible, are such as are the primary concern of metaphysics and theology: God, the soul and its immortality, and—more generally speaking—the ultimate realities of which phenomenal things, such as the sciences study, are appearances. Of these phenomenal things, we have ever-increasing and irrefragable knowledge; as to the things *per se,* the ontal or noumenal existents, of which the "things" of common sense and science are the knowable shadows or appearances, we can never have knowledge pure and subjectively undefiled. If we know *that* they are, we cannot know *what* they are; if we can assert their existence, we are ignorant as to their essence.

The name "agnosticism" was coined by Huxley about 1870 to distinguish this philosophical attitude from others, but the attitude had been professed before. It is, in fact, one of the issues of Kant's imposing theory of knowledge, and it had become, through the investigations of Sir W. Hamilton, Dean Mansel and Herbert Spencer, more sharply defined and more elaborately developed. Huxley, who was perhaps its most widely-known champion in the latter half of the 19th century, gave definiteness to its exposition by forcibly contrasting metaphysical and theological belief with scientific knowledge. We can now see that the controversial issue was confused, through failure at that time to realize that the word "knowledge" denotes not one sole psychological process and product, but several that are distinguishable; and also that what is called scientific knowledge is not quite so simple in its psychological structure, nor so logically "positive" in its nature, as the philosophically-inclined representatives of science in Huxley's day were wont to assume. The positivists who were led by the progress and prestige of physical science to regard science as constituted entirely by sense-data, linked together solely by relations such as could be read-off with the inevitableness and self-evidence of similarity, temporal sequence, etc., overlooked the fact, which had been clearly discerned by Hume, that we have no *logical* right to pass from our sporadic and evanescent sense-data, which yield evidence only as to here and now, to belief in a stable system of permanent things governed by law. The right is not a matter of logical necessitation but of psychological inevitableness; not of logical certification but of pragmatic verification; not of logical certainty but of personal certitude or sanguine confidence. Thus science is not knowledge, in the strict sense of reading-off, supplemented by logical inference. Such knowledge, and indeed the phenomenal objects about which it claims to know, are constituted such by suppositions that, in the first instance, are read *into* the data. Thus "knowing" means, in science of the actual, something different both from the immediate "acquaintance" of sense-perception and from the "truth" that is yielded by pure sciences, such as mathematics, whose "objects" are ideas—such as the line without breadth—and not actual things. This is also the doctrine of Kant. But Kant held that the reading-in that is involved in scientific knowledge is *a priori* necessary, so that such knowledge is knowledge in the strictest sense; whereas the reading-in that is involved in metaphysics and theology is but tentative and humanly expedient. This hard line between what Kant called understanding and reason—we might say between knowledge and mere belief—is now seen to be psychologically arbitrary, not so hard as he thought, and indeed to be drawn at the wrong place. Hence the rigid separation, once wont to be alleged between science and philosophy, and, on the strength of which, metaphysics and theology were disparaged, is no longer possible. The agnostic can no longer have that certainty as to the foundations of his science, in virtue of which he asserted nescience as to the non-phenomenal. The difference between the knowledge which he asserted and the knowledge which he disclaimed is one of degree of verifiability, not of kind or of intrinsic constitution.

But agnosticism, which issues out of Kant's phenomenalism, is imbued with consequences of what may be said to be another oversight of Kant, perhaps still more significant in import. Kant tried to work with the supposition that, though facts compel us to assert the existence of things *per se,* we can know no more about them. His doctrine implies that we can only know the phenomenal. This is the teaching that was developed by Hamilton into the dogmas that we can have no knowledge of the absolute or of ultimate reality, and no absolute or pure knowledge of anything: all knowledge is but relative. As to its Kantian foundation, it seems obvious that if we must posit things *per se,* in order to account for our sense-data being forthcoming, so must relations between things *per se* be posited to account for the stable connections between sense-data, which science elaborates into laws of nature. Indeed, unless we create most of our data out of nothing or out of our subjective states, etc., there must be structure and detail in the ontal corresponding to that which we observe in the phenomenal. Appearance cannot be appearance of nothing. Hence, instead of the Kantian formula, that we only know phenomena, it is more correct to say that we know the noumenal through the phenomenal. Thus there is not absolute nescience as to the noumenal, as agnosticism would assert. The most that can be urged is that we do not see the noumenal, so to say, through plate glass, but through the irremovable spectacles of the mind, which make a difference to the noumenal object or phenomenalize it. It is at this point that Hamilton's doctrine of the relativity of knowledge applies. He would regard phenomenal knowledge of the noumenal as not knowledge at all, because, in having it, we are not identical with the objects known nor become acquainted with them as they are in themselves. Our knowledge falls short of the ideal standard, in that it is impure—which is what he chiefly means by "relative." But it may be doubted whether knowledge suffers in value on that account. There is no reason to assume that, in imaging the real, the phenomenon veils it or caricatures and misrepresents it; it may reveal it, and reveal its significance just as effectually as would seeing face to face. What matters is that phenomenal knowledge should be *relevant* to reality, not that it should mirror its naked structure. An ordnance map serves all purposes of the tourist, though it may not mirror the coloured landscape or the geological formations of the district; it is relevant, if but appearance and not a copy. There is point-to-point correspondence between the lines and contours on the map and the streams, roads, gradients, etc., of the country which

it represents. Our phenomenal knowledge may bear—nay, must bear—much the same sort of relation as this to the realities which manifest themselves in and through the sensible and phenomenal. It enables us to "find our way about" our world, to be on terms of understanding with it and it may minister as much to spiritual wisdom as to practical prudence; for all that it is but phenomenal.

That "we see through a glass, darkly" may be our lot here: but it does not follow that we are wholly blind as to all that concerns our souls' health. Thus it would appear that agnosticism is superfluously modest. Its demurrer to the philosopher's claim that knowledge as to ultimate reality in general is inaccessible is not sustained.

If it would refuse the name of knowledge to such cognition it would seem to be cherishing a conception of knowledge to which no actually forthcoming "knowing" corresponds. For science itself, wont to be taken as the paradigm of knowledge, is at bottom interpretative, constructive, ejective and partly symbolical.

Its inductive method involves faith, for which there is reasonable, but not logical, justification And knowledge as to the objects with which metaphysics and theology are concerned, is but a further extension of the same method and the same sustaining faith as science uses, applied to such facts as evince meaning or purpose and value or significance, as well as to those which yield laws as to physical structure and connections.

BIBLIOGRAPHY.—J. Ward, *Naturalism and Agnosticism;* R. Flint, *Agnosticism* (1903). (F. R. T.)

**AGNUS DEI,** the figure of a lamb bearing a cross, symbolizing the Saviour as the "Lamb of God." The name is especially given in the Roman Church to waxen discs impressed with this figure and blessed by the pope. When first mentioned (*c.* 820) they were made of the remnants of the preceding year's paschal candle.

In modern times they are blessed on Easter Wednesday and distributed on the following Saturday, only in the first year of each pontificate and every seventh year after.

*Agnus Dei* is also the name for the invocation (based on John i, 29) *Agnus Dei, qui tollis peccata mundi, miserere nobis,* which appears to have been introduced into the Mass by Pope Sergius I (687–701).

It is there repeated thrice (the third time with *dona nobis pacem* for *miserere nobis*) between the Lord's Prayer and the communion: it is also appended to many of the litanies. The legality of its use in English, under certain conditions, in the Anglican communion service was upheld by the judgment in the Lincoln case (1890).

For the various ceremonies in the blessing of the *Agnus Dei, see* A. Vacant, *Dict. de Théologie* (cols. 605–613).

**AGOBARD** (*c.* 779–840), Carolingian prelate and reformer, became coadjutor to Leidrad, archbishop of Lyons, in 813, and on the death of the latter succeeded him in the see (816). Deposed in 835 by the council of Thionville, he made his peace with the emperor and was reinstated in 837. Agobard occupies an important place in the Carolingian renaissance. He wrote extensively not only theological works but also political pamphlets and dissertations directed against popular superstitions. He denounced the trial by ordeal of fire and water, the belief in witchcraft, and the ascription of tempests to magic, maintained the Carolingian opposition to image-worship, but carried his logic farther and opposed the adoration of the saints.

In his purely theological works Agobard was strictly orthodox, except that he denied the verbal inspiration of the Scriptures. Agobard was reverenced as a saint in Lyons, and although his canonization is disputed his life is given by the Bollandists, *Acta Sanctorum,* Jun. ii, 748.

BIBLIOGRAPHY.—Agobard's works were lost until 1605, when a manuscript was discovered in Lyons and published by Papirius Masson, again by Baluze in 1666. For later editions *see* Potthast, *Bibliotheca Historica Medii Aevi.* The life of Agobard in Ebert's *Geschichte der Litteratur des Mittelalters* (1880), is still one of the best to consult. For further indications *see* A. Molinier, *Sources de l'histoire de France.*

**AGONOTHETES,** in ancient Greece, the president or superintendent of the sacred games At first the person who instituted the games and defrayed the expenses was the Agonothetes. But in the public games, such as the Olympic and Pythian, these superintendents represented different States, or were chosen from the people in whose country the games were celebrated; thus at the Panathenaea at Athens ten *athlothetai* were elected for four years to superintend the various contests. They were variously called "regulators," "arbitrators," "judges of contests," "stewards of the games" (at Athens), "rod-bearers" (from the rod or sceptre emblematic of their authority), but their functions were generally the same.

**AGONY COLUMN,** a term often applied to the column in newspapers devoted to personal advertisements, such as announcements of losses or bequests. At as early a date as 1800 the "agony column" was a medium also for matrimonial advertisements It is sometimes known as the personal column

*See* Alice Clay, *The Agony Column of the "Times" 1800–1870* (1881).

**AGORA,** originally an assembly of the people of one of the Greek city States, called by the king or other authority to receive a decree or to discuss a policy. At an early period the word was used to describe the places where these meetings were held and in historic times any open space for general meetings, either official or commercial, was termed an agora. The agora of the historic Greek city was thus similar to the Roman forum or the mediaeval English market place. As the agora was the centre of the city life, it was surrounded by, or adjacent to the most important civic buildings, the prytaneum or official residence of the general, the basilica where the court sat, the *bouleuterion* or council hall, the thesaurus or treasury and the prison As the market place, it had ranges of sheds or colonnades for shops; frequently the colonnades were divided into parts, each named after the particular merchandise sold therein.

After the Persian wars the architectural treatment of the agora became much more monumental and lavish colonnades were frequently added to the older agorae, such as the Stoa of Attalus in the agora at Athens (between 159 and 138 B.C.). Of these later agorae many fine examples exist in various states of preservation. That at Ephesus was a square court over 500 ft. on the side, connected with additional courts containing a gorgeous nymphaeum and the lavish Roman library. At Priene the agora was traversed by streets but arranged so that through traffic was carried below on a detour. The substructures of the hillside agorae at Aegaea and Alinda still remain almost complete. In these cases the agora on a high terrace had large storage warehouses below. The great terrace wall at Alinda, with its striking rusticated masonry and large Roman arched openings, is especially impressive. Most important of all, however, is the agora at Assus, of which extensive remains still exist in a good state of preservation, with enough fragments to enable a complete and definitive restoration. This, like the two foregoing, is a hillside agora, supported on massive terrace walls. Its main architectural feature is the great two-storey portico.

The forum at Pompeii, in plan, dates probably from the time of the Greek colony. It therefore forms a connecting link between the Greek agora and the Roman forum. With its surrounding colonnade, its basilica, the city temple at one end and the civic offices at the other, it gives a perfect picture of what the typical Greek agora was like (For the agora at Athens *see* ATHENS.)

For a general discussion, *see* Cornish, *Dictionary of Greek and Roman Antiquities* (1898). The typical plan given is, however, absurd through its obvious misinterpretation of a passage in Pausanias in which he refers to colonnades separated by streets Pausanias plainly refers to streets traversing the agora and thus dividing the enclosing colonnade into separate sections *See* also S. H Bacon and Robert Koldewey, *Expedition of the Archaeological Institute of America* (investigations at Assus in 1881–83, 1902–21); Anderson and Spiers, *Architecture of Ancient Greece,* new ed. by W. B. Dinsmoor (1927).

**AGORACRITUS,** a Parian and Athenian sculptor of the age of Pheidias, and said to have been his favourite pupil. His most noted work was the statue at Rhamnus of Nemesis, by some

attributed to Pheidias himself. Of this statue part of the head is in the British Museum; some fragments of the reliefs which adorned the pedestal are in the museum at Athens.

**AGORANOMI.** Magistrates in Greece, whose duties were similar to those of the aediles of Rome. In Athens there were ten, five of whom took charge of the city and five of the Peiraeus. They maintained order in the markets, tested weights and measures, collected the harbour dues, and enforced the shipping regulations.

**AGORDAT,** a town of Eritrea, North-east Africa, on the route between Massawa and Kassala. It is connected by a railway, 194 miles long, with Massawa, via Asmara. At Agordat (Dec. 21, 1893) Italians under Colonel Arimondi defeated the followers of the khalifa. It was captured by British forces in March 1941.

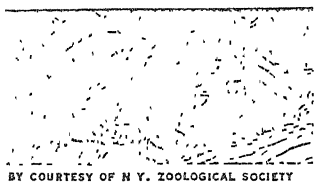
**AGOSTINO** and **AGNOLO** (or ANGELO) **DA SIENA,** Italian architects and sculptors in the first half of the 14th century. Della Valle and other commentators deny that they were brothers They certainly studied together under Giovanni Pisano, and in 1317 were jointly appointed architects of their native town, for which they designed the Porta Romana, the church and convent of St. Francis, and other buildings. On the recommendation of Giotto (*q.v.*), they executed in 1330 the tomb of Bishop Guido Tarlati in the cathedral of Arezzo, which Giotto had designed. This monument was destroyed by the French under the duke of Anjou.

**AGOSTINO** or **AGOSTINI (AUGUSTINUS), PAOLO** (1593–1629), Italian musician, was born at Valerano, and studied under G. B. Nanini. He succeeded Ugolini as conductor of the pope's orchestra in St. Peter's. Among his compositions is an *Agnus Dei* for eight voices, once greatly admired.

**AGOULT, MARIE CATHERINE SOPHIE DE FLAVIGNY,** COMTESSE D' (1805–1876), French author, whose *nom de plume* was "Daniel Stern," was born at Frankfurt-on-Main on Dec. 31, 1805. Her father was a French officer who had served in the army of the emigrant princes, and her mother was the daughter of a Frankfurt banker. She was married in 1827 to the comte Charles d'Agoult. In Paris she gathered round her a brilliant society which included Alfred de Vigny, Sainte-Beuve, Ingres, Chopin, Meyerbeer, Heine and others. She was separated from her husband, and became the mistress of Franz Liszt. During her frequent travels in Switzerland, France and Italy she made the acquaintance of George Sand, and figures in the *Lettres d'un voyageur* as "Arabella." By Liszt she had three children—a son who died young; Blandine, who married Émile Ollivier; and Cosima, who married first Hans von Bülow and later Richard Wagner. The story of her breach with Liszt is told under a very slight disguise in her novel *Nélida* (1845). On her return to Paris in 1841 she began to write for the *Presse,* and later for the *Revue des deux Mondes* and the *Revue indépendante.* Mme. d'Agoult was an ardent apostle of the ideas of '48, and from this date her *salon,* which had been literary and artistic, took on a more political tone; revolutionists of various nationalities were welcomed by her, and she had an especial friendship and sympathy for Daniele Manin. In 1857 she produced a national drama, *Jeanne D'Arc,* which was translated into Italian and presented with success at Turin. The most important section of Daniel Stern's work is her political and historical essays. *Lettres républicaines* (1848), *Esquisses morales et politiques* (1849), *Histoire de la Révolution de 1848* (1850–1853), *Histoire des commencements de la République aux Pays-Bas* (1872). Mme. d'Agoult died in Paris March 5, 1876.

*See* Mme. d'Agoult, *Mes Souvenirs* (1806–33), 1877; J. Mazzini, *Lettres de Joseph Mazzini à Daniel Stern* (1872); A. Pommier, *Madame la comtesse d'Agoult* (Daniel Stern), 1876; A. Cuvillier Fleury, *Portraits révolutionnaires,* vol. i. (1889); A. Ungherini, "Daniel Stern" in the *Revista repubblicana* (1880, No. 9); S. Rocheblave, *Une Amitié romanesque, George Sand et Madame d'Agoult* (1895); R. Bory, *Une Retraite romantique en Suisse; Liszt et la comtesse d'Agoult* (1923), with an appendix containing letters; Daniel Oliver, *Mémoires de la comtesse d'Agoult: 1833–54* (1926).

**AGOUTI** or **AGUTI** (a-gōō-tĕ), rodent (*Dasyprocta aguti*), of the size of a rabbit, common to Trinidad and Guiana, and related to the guinea pigs. Agoutis are slender-limbed animals, with five front and three hind toes (the first front toe very minute), and short tails. The hair is coarse and rough; the colour being rufous brown. In habits agoutis are nocturnal, dwelling in forests, where they conceal themselves during the day in hollow tree-trunks, or in burrows among roots. They take readily to water and swim well. Their food comprises leaves, roots, nuts and other fruits. They do much harm to sugar-cane. (*See* RODENTIA.)



BY COURTESY OF N Y. ZOOLOGICAL SOCIETY

THE AGOUTI, COMMON IN EASTERN SOUTH AMERICA, AND DESTRUCTIVE TO SUGAR CANE AND BANANA PLANTS

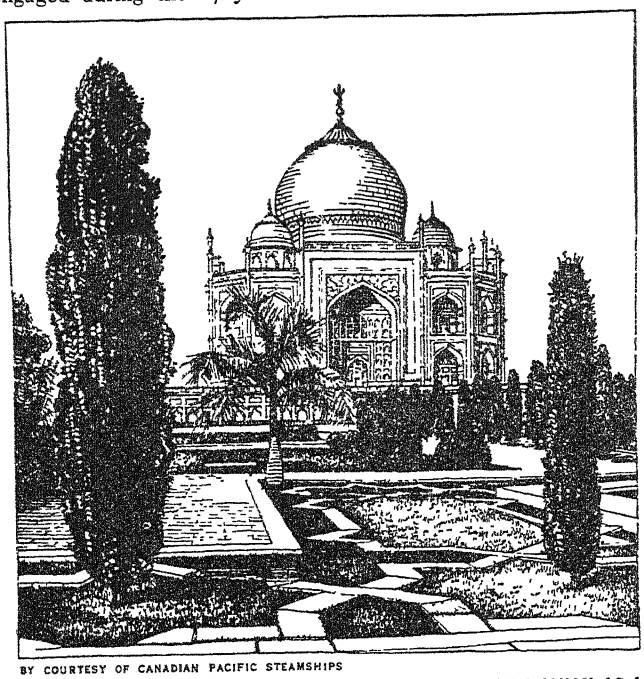
**AGRA,** the headquarters of a district, division and province of the same name in the United Provinces of Agra and Oudh (*q.v.*), was for long periods the capital city of India. Pop. (1941) 284,149. It stands on the Jumna which, though now at this point a mere trickle in the dry season, was formerly one of the chief arteries of commerce with the rest of India and at the same time a powerful frontier defence. Of the original Agra, which apparently lay on the left bank of the river, practically no traces remain. The present city on the right bank was the creation of the Mohammedan conquerors. The earlier dynasties fluctuated between Delhi and Agra as their centre of power; but it was at Agra that Sikander Lodi (A.D. 1500) set up his court, deeming it the strategic point for holding in check his turbulent vassals to the south. In 1526 the city was captured by Baber, the Koh-i-nor diamond being part of his booty. It was here that he decided to occupy India in permanence; here also that he died. It was his grandson Akbar who began to build the present fort (still by the people called Akbarabad), ruled India from within the walls, died in it, and was buried at Sikandra a few miles beyond the city gates. Agra fell from its pride of place when Aurangzeb moved to Delhi, and was never again the seat of monarchy. In the latter half of the 18th century, it was captured successively by the Jats, the Mahrattas, the Mohammedans and Scindhia; but it was finally taken by Lord Lake in 1803. After British rule was extended to upper India, it became the capital of the North-West provinces until at the close of the Mutiny the seat of that Government was transferred to Allahabad. The city is now a busy railway and commercial centre with cotton mills, gins and presses, flour mills and an important carpet industry.

There are two large colleges and several other educational institutions, including a medical school for men and women.

Although to travellers Agra is essentially the city of the Taj, it enshrines several other magnificent specimens of Mogul architecture, each perfect of its kind. The fort, with its lofty walls of red sandstone 1½m. in circumference, contains at least two such gems. Separated from each other by the main block of the buildings of the imperial court, stand on the north the Pearl Mosque, built by Shah Jahan, and on the south the Jahangiri Mahal or palace built by Akbar; the former unequalled for the beauty and purity of its proportions, material and constructive design in simple white marble; the latter a perfect adaptation of stately solidity and commanding symmetry of the Hindu style. If we leave the fort and cross the river, we find another gem of its kind in the tomb of Itmad-ud-Daulah, father of Jahangir's empress. Its architecture is transitional between the virile conceptions of Akbar and the poetic richness of Shah Jahan; elegant, elaborate and scholarly, it was the first triumph of marble inlaid work in direct imitation of Persian pottery decoration. Five miles from Agra is Sikandra, where Akbar was buried, though his remains were desecrated and scattered by Jat freebooters in later years. His tomb is a noble building in a noble setting, and the marble sarcophagus on its roof is strikingly impressive in its simple dignity. Far exceeding all the others in glory is the Taj, the most beautiful mausoleum in the world. It was built by Shah Jahan for his empress, who died in A.D. 1631; and from one of her titles, Taj Mahal or Crown of the Palace, it takes the name by which it is most generally known outside India. Built of pure white marble, it stands on a vast marble terrace, crowned by a great dome in the centre and smaller domes at each of its corners. From the angles of the terrace rise

four slender minarets. Subservient and supplementary to the glory of the outline is the beauty of the ornamentation. "All the spandrils of the Taj," writes Fergusson, "all the angles and more important architectural details are heightened by being inlaid with precious stones such as agates, bloodstones, jaspers and the like. These are combined in wreaths, scrolls and frets as exquisite in design as they are beautiful in colour, and relieved by the pure white marble in which they are inlaid, they form the most beautiful and precious style of ornament ever adopted in architecture."

The architect of the Taj was Ustad Isa, variously described as a Byzantine Turk, and as a Persian from Shiraz. The artificers engaged during the 17 years of its construction came from all



BY COURTESY OF CANADIAN PACIFIC STEAMSHIPS

THE TAJ MAHAL AT AGRA, ERECTED BY THE EMPEROR SHAH JAHAN AS A MAUSOLEUM FOR HIS EMPRESS WHO DIED IN A.D. 1631. THE ARCHITECT WAS USTAD ISA

parts of Asia and probably included a French goldsmith, Austin de Bordeaux.

The district of Agra has an area of 1,861 sq.mi. Its general appearance is that common to the Doab, a level plain intersected by watercourses with fringes of ravines. Its general elevation is estimated at from 650 to 700 ft above the level of the sea. The district is intersected by the Jumna, and is also watered by the Agra canal. The principal crops are millets, pulses, barley, wheat, cotton and a little indigo. The population in 1941 was 1,289,774

The division of Agra has an area of 8,646 sq mi. In 1941 the population was 5,326,768. It comprises the five districts of Aligarh, Muttra, Agra, Mainpuri and Etah

**AGRA CANAL,** primarily an irrigation project opened in 1874, but widely used for navigation It is supplied with water from the Jumna river and beginning at Okla, 10 m. below Delhi it passes through the districts of Delhi, Gurgaon, Muttra and Agra as well as the Bharatpur state. It finally joins the Banganga river about 20 m. below Agra.

**AGRAM:** *see* ZAGREB

**AGRAPHA,** the name given to certain utterances ascribed, with some degree of certainty, to Jesus, which have been preserved in documents other than the Gospels, *e.g.*, Acts xx. 35; 1 Tim. v. 18; 1 Cor. vii. 10–12, and the Logia (*q.v.*) discovered in 1897 and 1903 at Oxyrhynchus.

BIBLIOGRAPHY.—*See* A. Resch, *Agrapha* (Leipzig, 1889); J. H. Ropes, *Die Spruche Jesu* (Leipzig, 1896); and the article "Sayings" in J. Hastings's *Dictionary of Christ and the Gospels.*

**AGRARIAN LAWS,** law dealing with the disposal of the public land (*ager publicus*) of ancient Rome No gratuitous disposition of state property could be made without the consent of the people. Hence many of the ordinances affecting the public land were laws (*leges*) in the strictest sense of that word. It is, however, convenient to consider in this article all the regulations that were made for the administration of the public land by the executive authorities, as well as by the people during the republic, and by the commands of the emperor. These had the force of law during the principate

Public land was the prize of conquest and was one of the means of defraying the expenses of state administration. For this purpose land was often leased on the condition of the payment of dues. But it was made to fulfil another purpose, the satisfaction of the individual needs of poorer citizens. To this end land was assigned, and on assignment ceased to be the property of the state. But it often happened that the state was not disinterested in such acts of assignment It gained security and territorial control by planting garrisons in conquered country, and it relieved itself of the necessity of providing for its poorer classes by state-aid. The connection between agrarian legislation and colonization can be seen at once, and also the two aspects of colonization—the military and the social. These two objects were connected throughout the whole of the earlier period of Roman agrarian assignation. After the time of the Gracchi social motives continued to be operative when military precautions had ceased to be necessary One of the motives which prompted infant Rome to war with her neighbours was the land-hunger of her citizens. This hunger she satisfied after conquest by annexing a portion of the enemy's territory. The amount thus confiscated varied. It was usually a third, but sometimes a half or even two-thirds, and after the fall of Capua in the Second Punic War the whole territory of the state was annexed. By the close of the 2nd century B.C. one-half of the land of Italy belonged to Rome whether in private ownership or as the property of the state. Annexation was carried on in the provinces on a smaller scale; but Rome retained as domain-land much of the territory of communities which had been destroyed (*e.g.*, Carthage and Corinth), and the estates of former kings. This peculiar property of the Roman state in the provinces must be carefully distinguished from the general overlordship which Rome was supposed to hold over all provincial soil, expressed in the statement that provincials had only possession or usufruct of land.

**Methods of Handling Public Land.**—Such portions of the territories of conquered cities as were not claimed by Rome were left in the possession of these cities. If the city was a federate state (*civitas foederata*) this possession was guaranteed by a treaty; if it was a free city, the guarantee was made by charter; where Rome had marked out territory for assignment to her own citizens, but where, in or near the limits of the assignment, some of the land had been left in the hands of its former proprietors, such land was noted in the state registers as *redditus veteri possessori.*

The State dealt in two ways with such land as it retained. It alienated it, in exchange for a price or gratuitously; or it kept it as a source of revenue, whether on lease or on some system of remunerative occupation. The land might be sold for the benefit of the treasury. Typical instances of this treatment are furnished by the sale of some Campanian land during the Second Punic War. The censors may have directed the sale, but it was executed by the quaestors as the regular officials of the treasury. Hence such land was described as *ager quaestorius.* The land was sold in definitely marked out plots, and when this sale had been effected the lots fell under the absolute ownership of their purchasers.

The second mode of alienation was that by assignation. Lands thus assigned were known as *agri dati adsignati.* The gift on the part of the State was gratuitous, and ownership passed wholly to the assignee. The land so given was definitely surveyed, marked out, and registered. Such an assignment might take one of two possible forms. It might be the means of establishing a new "plantation" (*colonia*), with some independent organization of its own, or it might be the means of providing allotments for individuals who remained domiciled at Rome or in some already existing municipality. The amount granted to individuals in assignments of both types varied from time to time It was reckoned in terms of the *iugerum,* which was approximately five-eighths of an English acre. The earliest and smallest assignment was two *iugera:*

14 *iugera* was the maximum amount granted before the time of Ti. Gracchus (133 B.C.), and it was held by representatives of the old school that seven *iugera* were as much as any frugal Roman should want. The division was carried out by commissions appointed by the people. The land which the State retained as *ager publicus* was always placed in the hands of individuals, who occupied it in some manner remunerative to the State These individuals (*possessores*) were never regarded as owners of the land thus occupied. It remained the property of the State, was held without a contract (*precario*), and could be resumed by the State at will. But though the tenants had no claim against the State, their ownership could be defended against all other claimants; from an early date the praetor's possessory interdict was used to protect all occupiers, provided their tenure had not been acquired by force (*vi*), by seizure of land in its occupiers' absence (*clam*), or by mere permission of the previous holder to occupy (*precario alter ab altero*). Tenants of this type could transfer their land by inheritance, and the land was accepted as security by creditors. This kind of occupation, therefore, though clearly distinguished from ownership (*dominium*), was yet regarded as a perfectly secure form of tenure. All occupiers of public land paid dues to the State through a state contractor (*publicanus*). These dues varied in amount and in the method of their collection. We learn from Appian that the ordinary dues paid by occupiers of arable land in Italy were one-tenth of seed crops and one-fifth of plant produce. Owners who turned cattle or sheep on pasture land belonging to the state also paid fixed dues to the treasury. The occupiers of the Roman public land in Campania paid a large rent. The conditions of the tenure of the Roman public land in Africa are known to us from the *Lex Agraria* of 111 B.C. The *publicanus* is the middleman between the State and the *possessor* and purchases from the censor the right of collecting dues. The law places no restriction on bargaining between the censor and the *publicanus,* but enacts that no *possessor* or *pastor* shall ever be required by the *publicanus* to pay more than the amount prescribed by the censors of 115 B.C. These conditions may be regarded as typical for the occupation of public lands. When Cicero speaks of public land as let on lease (*locatus*) by the censor, he refers to the leasing of the taxes to a *publicanus* for a fixed period, and not to the letting of the land. This seems clear from a passage (*In Verr.* iii. 6. 12) where he speaks of land in Sicily which had been restored by Rome to former owners as being leased. The land itself could not be leased by Rome if it belonged not to Rome but to the Sicilian inhabitants; but the collection of the revenues due to Rome could be so leased to *publicani* (*q.v.*). The same explanation would apply to Cicero's statements that the Campanian land was let on lease by the censors. Cicero's repeated statement that the Campanian land was expressly exempted from the legislation of the Gracchi shows that there was not sufficient distinction between the Campanian tenure and that of other public land in Italy to make this definite exception by name superfluous. The Sempronian law could obviously not touch land which the State had leased to occupiers on the basis of a definite contract. It seems certain that in every case the *possessor* occupied *precario,* and that only in the bargain between the censor and the middleman was there room for contract. Thus the State was justified in the claim to resume public land which it made in many of the agrarian laws.

**Survey of Agrarian Legislation.**—The earliest agrarian measures of which we have any record are the distributions to poor citizens of land conquered in war, which later authorities attribute to Numa and Servius Tullius. Such assignments were a voluntary surrender on the king's part of his own portion of the spoils. The agrarian law of Spurius Cassius (486 B.C.) distributed *ager publicus* among the plebeians. Another agrarian law proposed by the tribune Lucius Icilius in 456 B.C. regulated the tenure of public land on the Aventine. In 376 B.C. the tribunes Licinius and Sextius introduced into their laws, for the promotion of the privileges of the *plebs,* a clause enacting that no more than 500 *iugera* of land should be occupied by a single cultivator; the law also enacted that only 100 cattle and 500 sheep might be turned by one owner on the public pastures. But it failed of its object because it did not provide any adequate machinery for the resumption by the state of land held in excess of the prescribed amou therefore easily evaded. The next agrarian law wa dealing with lands conquered from the Senones (*q v.* tines. In 232 B C C. Flaminius, tribune of the *plebs,* pro resume these lands for the state, although they were already occupied by large landholders, and to distribute them in allotments to poor citizens. The measure met with much opposition from the richer classes, and did not gain the sanction of the senate; but C. Flaminius ignored constitutional usage and brought it direct before the council of the *plebs,* by which it was made law. In 133 B C. the tribune Tiberius Gracchus (*q v.*) re-enacted the earlier measure of Licinius and Sextius, with the additional provisions that each owner might occupy 250 *iugera* for each son, in addition to the original 500, and that a commission of three (*III. viri agris dandis adsignandis*) should be appointed to carry out the terms of the law He also enacted that the land occupied in excess of the prescribed amount, and on that account resumed for the State by the land commission, should be distributed in inalienable lots to poor citizens. Subsequent modifications of those provisions which dealt with the powers of the land commission led to a re-enactment of the whole by G. Gracchus (*q v.*), the brother of Tiberius, tribune in 123 B C But within 15 years from the tribunate of G. Gracchus the whole of his law had been rendered null by three further enactments. The first of these permitted the sale of land allotted under the law, which thus tended to return into the hands of its former occupiers as private property, which the State had no longer any right to resume. The second abolished the commission appointed to carry out the terms of the law, thus putting a stop to further resumption and distribution, and also transformed existing occupiers into owners of the land they occupied, paying only a small due to the treasury. The third abolished the payment. That law belonged to the year 111 B.C.

From that time forward a change came over land legislation. The ordinary public land in Italy, in the hands of occupiers, which had given rise to all the agrarian legislation between 376 and 111 B.C. had practically ceased to exist. The Campanian land still remained, but the same reasons which led to [illegible] from the Gracchan legislation seem to have continued to protect its holders until 63 B.C In the meantime several agrarian laws were passed which provided for the distribution of land placed in some other way at the disposal of the State. In 100 B.C. Appuleius Saturninus (*q.v.*) tribune, proposed the allotment of lands recently taken from the Cimbri in Gaul. This law was passed but eventually declared null by the senate, with the rest of Saturninus's laws. A more dangerous precedent was set by Sulla in his dictatorship (82–81 B.C.). He was the first to confiscate the lands of his political opponents and of communities which had resisted him and, treating them as *ager publicus,* assign them to his veterans as a prize. This example was followed by Octavian (Augustus) and Antony (M. Antonius) after their proscriptions in 43 B.C. A third method of providing land for distribution was that adopted by Servilius Rullus (*q.v.*) in 63 B.C. His bill enacted that land should be purchased in Italy with money gained by the sale of Roman territories abroad, and allotted to citizens. A commission of ten (*X. viri agris dandis adsignandis*), annually elected by nine out of the 35 tribes, was to carry out the terms of the law. Rullus also ventured to propose the distribution of the Campanian land which had hitherto been respected by all agrarian reformers. It was chiefly on this ground that Cicero in his three speeches on the Agrarian law succeeded in exciting such a general feeling against it that it was eventually withdrawn. In 60 B.C. the tribune L. Flavius brought forward a bill for the distribution of lands to Pompey's veterans. The Campanian land was certainly to be included in the distribution, and it is clear from Cicero that the bill in some way dealt violently with the rights of private owners. It also, however, enacted that land should be purchased by the State with the wealth which Pompey's conquests had brought into the treasury. The last proposal was supported by Cicero, but the bill seems to have been dropped, only to reappear in more moderate form in the following year. A consular bill, the *lex Iulia Campana,* was passed by Julius Caesar in 59 B.C., which provided for the settlement of Pompey's veterans on the Campanian land, and other lands pur-

based by the state from private owners in Italy with the full consent of the latter. In its original form, the bill omitted all reference to the Campanian land, which seems to have been included by Caesar in the distribution only when the continued and unreasoning opposition of the senate had goaded him to extreme measures. A commission of twenty was to be appointed to carry out the law, from which Caesar himself was expressly excluded. This measure finally settled the question of the Campanian land, which now passed out of the category of *ager publicus*. The last agrarian law of the republic was that passed in 44 B.C. on the proposal of the consul M. Antonius. We have no detailed account of the measure, but it seems to have provided grants of land for veterans, and was to be administered by seven commissioners. The law was afterwards cancelled by decree of the senate.

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**AGRARIAN MOVEMENT:** *see* LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS.

**AGREDA, MARIA FERNANDEZ CORONEL,** ABBESS OF, known in religion as Sor (Sister) Maria de Jesus (1602–1665), was born at Agreda, on the borders of Navarre and Aragon, on April 2, 1602. All her family were powerfully influenced by the ecstatic piety of Spain in that age. From childhood she experienced ecstasies and visions. When she was fifteen the whole family entered religion. Maria, her mother and sister established a Franciscan nunnery in the family house at Agreda, which, when Maria's reputation had extended, was replaced by the existing building. She began it with one hundred reals (one pound sterling) lent her by a devotee, and it was completed in fourteen years by voluntary gifts. Much against her own wish, we are told, she was appointed abbess at the age of 25. Though the rule required the abbess to be changed every three years, Maria remained the effective ruler of Agreda till her death. In the earlier part of her life, while the Franciscan, Francisco Andres de la Torre, was her confessor, she wrote an *Introduction to the History of the Most Blessed Virgin.* It was destroyed by the direction of another confessor. Later on, under the guidance of her Franciscan confessor, Andres de Fuen Mayor, she wrote *The Mystic City of God.* It is an extraordinary book, full of apocryphal history, visions, and scholasticism. In 1642 she sent to Philip IV. an account of a vision of a council of the infernal powers for the destruction of Catholicism and Spain. The king visited her when on his way to Aragon to suppress the rebellion of Catalonia. A long correspondence, which lasted till her death on March 29, 1665, was begun. The king folded a sheet of paper down the middle and wrote on the one side of the division. The answers were to be written on the other and the sheet returned. How far Maria was only the mouthpiece of the Franciscans must of course be a matter of doubt. Her correspondence was apparently suspended whenever her confessor was absent. The letters are in excellent Spanish, are curious reading, and are invaluable as illustrations for the second part of the reign of Philip IV.

The correspondence of Sor Maria with the king has been published in full by Don F. Siluela, *Cartas de la Venerable Madre Sor Maria de Agreda y del Señor Rey Don Filipe IV.* (1885). *The Mystic City of God* continued to be much in favour with supporters of the dogma of the Immaculate Conception. It appeared in Madrid in 1668, with a biographical introduction by Samaniego, has been often reprinted, and was translated into French and Italian. It was for a time reserved by the Index, both Spanish and Papal, but was taken off by the influence of the Franciscans and of Spain, the chief supporters of the Immaculate Conception. An account of Maria de Agreda will be found in the *Tracts* of Michael Geddes (1706), vol. iii., written by a competent critic and Anglican divine of the 18th century who detested "enthusiasm."

**AGRÉMENTS** (Ital. *abbellimenti;* Ger. *Manieren;* Eng. *ornaments*), in music, are supplementary notes, or embellishments, introduced for the purpose of enriching, elaborating or otherwise altering the effect of the phrase or melody to which they are applied. As employed in connection with the older types of music, alike vocal and instrumental, they assumed a large variety of forms (acciaccatura, appoggiatura, arpeggio, mordent, shake, turn, and so on) which in course of time became definitely standardized and so formed an essential part of the music, although nominally left to the discretion of the performer and indicated, if at all, only by conventional signs.

**AGRIANES,** a warlike tribe anciently inhabiting Upper Macedonia, and part of what is now south-western Bulgaria. They provided some of the most active and dangerous of the troops of Alexander's army, distinguishing themselves at the Granicus, Issus and on the banks of the Jhelum.

**AGRICOLA, GEORGIUS** (GEORGE BAUER) (1494–1555), German scholar and man of science, known as "the father of mineralogy," was born at Glauchau in Saxony on March 24, 1494 After studying philology at the universities of Leipzig, Bologna and Padua, he earned a degree in medicine at the University of Ferrara. From 1527 to 1533 he was city physician in the flourishing mining town of Joachimsthal in Bohemia and from 1534 to the end of his life [illegible] in Chemnitz. He adopted the Latinized form of his name and wrote in Latin. Although he made contributions to medicine, mathematics, theology and history, his most important writings were on mineralogy and mining. Living in what was then the greatest mining region in Europe, and in close touch with all phases of the industry, his intimate and practical knowledge enabled him to become the first writer on these subjects to rely on direct observation rather than on speculation. He exerted a direct influence on his contemporaries and successors and through them on the development of geological science. Best known of his six books on geological subjects is *De re metallica,* published posthumously in 1556. It deals chiefly with the arts of mining and smelting and contains many informative and attractive woodcuts.

In his *De natura fossilium* (1546), translated into German by Ernst Lehmann (Freiberg, 1809–10), and considered the first mineralogy textbook, he presented a new classification of minerals based on their physical properties, and described many new minerals, chiefly metallic ores, their occurrence and mutual relationships. His first mineralogical work, *Bermannus, sive de re metallica dialogus* (1530), a treatise on the Erzgebirge mining district, was translated into English by Herbert Hoover and his wife. In *De ortu et causis subterraneorum* (1546) he recognized clastic rocks and mineral-bearing solutions. His other geological works are *De natura eorum quae effluent ex terra* (1546) and *De veteribus et novis metallis* (1546). He died Nov. 21, 1556.

*See* Reinhold Hofmann, *Dr. Georg Agricola* (Gotha, 1905); Ernst Darmstaedter, *Georg Agricola, Leben und Werk* (Munich, 1926); Frank D. Adams, *The Birth and Development of the Geological Sciences,* pp. 93–94, 183–95 (1938). (L. Ws.)

**AGRICOLA, GNAEUS IULIUS** (A.D. 37–93), Roman general, father-in-law of the historian Tacitus, was born on June 13, A.D. 37 (according to others, 39) at Forum Iulii (Fréjus) in Gallia Narbonensis. His grandfathers were of equestrian rank; his father became a senator, but was put to death by Caligula. Agricola was brought up by his mother at Massilia. He entered the army and served (59) under Suetonius Paulinus in Britain. In 61 he returned to Rome, where he married Domitia Decidiana, a Roman lady of distinction. In 63 he was quaestor in Asia, in 65 tribune, in 68 praetor, and when Vespasian was proclaimed emperor, he immediately declared himself his supporter. In 70 he was appointed to the command of the 20th Legion in Britain, then stationed at Deva (Chester). On his return to Rome, at the end of three years, he was made censor, raised to the rank of patrician, and appointed governor of Aquitania (74–78). Appointed *consul suffectus* in the following year, he was admitted into the college of pontiffs and made governor of Britain. In the same year he betrothed his daughter to Tacitus.

Agricola spent at least seven years in Britain. After conquering the Ordovices in North Wales and the island of Mona (Anglesey), during the next two years he advanced to the Taüs (Tay; others read Tanaus, perhaps the north Tyne), and in his fourth campaign fortified the country between Clota and Bodotria (the firths of Clyde and Forth) as a protection against the attacks of the Caledonians. Having explored the coasts of Fife and Forfar, he gained a decisive victory over the Caledonians under Galgacus at the

Graupian hill. (*See* BRITAIN: *Roman*) Between campaigns he busied himself in helping forward the Romanization of his province. But his successes had aroused the suspicion of Domitian. He was recalled to Rome, where he lived in retirement, refusing the proconsulship of Asia. He died in 93, poisoned, it was rumoured, by the emperor's orders.

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**AGRICOLA, JOHANNES** (originally Schneider, then Schnitter) (1494–1566), German Protestant reformer, was born April 20, 1494, at Eisleben, whence he is sometimes called *Magister Islebius*. He studied at Wittenberg, where he met Luther. In 1519 he accompanied Luther to the great assembly of German divines at Leipzig, and acted as recording secretary. He taught and preached the Lutheran doctrine in Frankfurt, Eisleben and Wittenberg, but in 1536 an old controversy broke out more violently than ever. Agricola was the pioneer of the Antinomian heresy, which maintained that while the unregenerate were still under the Mosaic law, Christians were entirely free from it, being under the gospel alone. During the bitter controversy with Luther that followed, Agricola in 1540 left Wittenberg secretly for Berlin, where he addressed a letter to the elector of Saxony, which was generally interpreted as a recantation of his views. Luther, however, was not satisfied, and Agricola remained at Berlin, where Joachim II of Brandenburg appointed him court preacher and general superintendent. With Julius von Pflug and Michael Helding, he prepared the Augsburg Interim of 1548. He endeavoured in vain to appease the Adiaphoristic controversy (*see* ADIAPHORISTS). He died during an epidemic of plague on Sept. 22, 1566.

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**AGRICOLA, RODOLPHUS** (properly ROELOF HUYSMANN) (1443–1485), Dutch scholar, was born at Baflo near Groningen, Aug. 23, 1443. He was educated at Louvain, Paris, and at Ferrara, where he attended the lectures of the celebrated Theodorus Gaza (1400–78) on the Greek language. In 1482, on the invitation of Johann von Dalberg, bishop of Worms (1445–1503), he accepted a professorship at Heidelberg, and for three years delivered lectures there and at Worms on the literature of Greece and Rome. By his personal influence more than by his writings he did much for the renaissance of learning in Germany; and Erasmus and other critics of the generation immediately succeeding his are full of his praises. He died at Heidelberg on Oct. 28, 1485. His principal work is *De inventione dialectica, libri iii*, in which he attacks the scholastic philosophy of the day. His collected works were edited by Alard (Cologne, 1539).

*See* T. F. Tresling, *Vita et Merita Rudolphi Agricolae* (Groningen, 1830); v. Bezold, *R. Agricola* (München, 1884); and Ihm, *Der Humanist R. Agricola, sein Leben und seine Schriften* (Paderb., 1893).

**AGRICULTURAL ARTICLES.** Agriculture is treated in these pages under various headings, an enumeration of which will help the reader to consult any part of the subject.

For a general account of agriculture, reference should be made in the first place to the articles AGRICULTURE: A GENERAL SURVEY; AGRICULTURE, PRIMITIVE; FARM; GARDEN; HORTICULTURE; and to the sections on agriculture appended to the articles on the different countries.

As to the operations on agriculture, *see* the articles AGRICULTURAL ENGINEERING; AGRICULTURAL POWER AND MACHINERY; ARABLE; BAULK OR BALK; CROP-DRYING; CULTIVATION; ELECTRICAL POWER IN AGRICULTURE; FALLOW; FARM BUILDINGS; FERTILIZERS; FLAIL; FORK; GUANO; HARVEST; HARVESTING MACHINERY; LAND RECLAMATION; LIMING; LOAM; OPEN-FIELD SYSTEM; PLANT BREEDING; PLANTING MACHINERY; PROCESSING MACHINERY; REAPING; ROTATION OF CROPS; SOIL; SOWING; SPRAYING AND DUSTING MACHINERY; THRASHING OR THRESHING; TILLAGE; TILLAGE MACHINERY; TRACTORS.

The business and organization of agriculture will be found treated under AGRICULTURAL CO-OPERATION; AGRICULTURAL CREDIT; AGRICULTURAL ECONOMICS; AGRICULTURAL EDUCATION; AGRICULTURAL INSURANCE; AGRICULTURAL ORGANIZATION; AGRICULTURAL RESEARCH; FARM MANAGEMENT (including farm organization and equipment); and FARM VALUATIONS.

LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS is treated under that heading, and there are articles on ALLOTMENTS; FARM RENTS; and SMALL HOLDINGS. The various institutions connected with agriculture are treated under the headings AGRICULTURAL SOCIETIES AND SHOWS; AGRICULTURE, CHAMBERS OF; AMERICAN FARM BUREAU FEDERATION; FARM COLONY; FARMERS' CLUBS, FARMERS' ORGANIZATIONS, FARMERS' UNION; GRANGE, THE; INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS; and INTERNATIONAL INSTITUTE OF AGRICULTURE. For a discussion of farm relief legislation after 1928 in the United States *see* FEDERAL FARM BOARD. For statistics *see* AGRICULTURAL PRICES; AGRICULTURAL STATISTICS: and AGRICULTURE, CENSUS OF.

As to agricultural employment, the articles AGRICULTURAL GANGS; AGRICULTURAL LABOURER; and AGRICULTURAL WAGES should be consulted. Coming to agricultural production, in addition to general articles entitled AGRONOMY; ARVICULTURE; CEREALS; COTTON AND THE COTTON INDUSTRY; CROPS; GRAIN PRODUCTION AND TRADE; SUGAR; and WHEAT, there is an article on GRASS AND GRASSLAND which includes the discussion of hay crops and pastures.

As to animals, articles may be consulted on ANIMAL BREEDING; BRANDING; BREEDS AND BREEDING; CATTLE; HORSE; MERINO; OX; PIG; SHEEP; and STOCKYARDS.

There are articles on ENSILAGE; FEEDING STUFFS AND LIVESTOCK FEEDING; and FORAGE. Articles will be found on ARBOR DAY; ARBORICULTURE; BEE; COPPICE OR COPSE; CREAMERIES; DAIRY FARMING; EGG, ESPALIER; FORESTS AND FORESTRY; FRUIT FARMING; HONEY; POULTRY AND POULTRY FARMING; TOBACCO; TREE; and TURKEY.

There is a special article on TROPICAL AGRICULTURE.

**AGRICULTURAL CO-OPERATION.** The development of agricultural co-operation has taken widely different courses in various countries according to their specific needs. The main difference to be observed is between countries which are primarily producers of agricultural commodities for export, and those which produce mainly for home consumption. In the former, the co-operative movement has chiefly concentrated upon the organization of marketing; in the latter—apart from the development of rural credit and insurance—mainly upon the purchase of farm requisites, or the formation of co-operative dairy, bacon or other producing societies. Although this broad distinction holds good, it is nevertheless true that practically all types of co-operation are to be found to a greater or lesser extent in the principal agricultural countries.

**Co-operation in Great Britain.**—Agricultural co-operation in Great Britain may be said to have begun with isolated experiments during the 19th century, but very little resulted from these early attempts. The Agricultural Organization society in 1901 was the centre of the movement from its formation until it was wound up in 1924. During this period a great many societies were established.

The period following the war of 1914–18 brought forth a considerable intensification of the efforts to promote co-operation amongst British farmers, and the Agricultural Organization Society was assisted by grants from the state. A number of new societies were formed between 1918 and 1924. Unfortunately these efforts met with only limited success, and the creation of new societies was largely offset by a considerable number of failures. This was due to several factors—to the rapid fall in agricultural prices which took place after the spring of 1920, to the fact that a large number of the new societies were small and financially weak and were therefore unable to secure competent management, to the failure of many societies to adopt certain principles in co-operation which in other countries had proved to be essential, and

to the lack of interest shown by farmers themselves

Among agricultural co-operative societies in Great Britain the most successful have been the relatively large-scale societies concerned with the supply of farm requisites, a few dairy societies, and a certain number of others engaged in the sale of eggs, wool, fruit and vegetables, etc. Mention should be made of the formation of the Agricultural Wholesale Society in 1918, which was an attempt to provide a central wholesale organization from which the local requisite societies could obtain their supplies; its relation to the latter was similar to that between the co-operative wholesale societies and the retail consumers' co-operative societies. Such central wholesale societies had for some years been an integral part of the agricultural co-operative organization in several European countries.

**Co-operation in Europe.**—In western Europe, where the majority of countries were importers of food or were approximately self-supporting, the growth of co-operation was mainly in the direction of developing rural credit societies (*see* AGRICULTURAL CREDIT) or of societies for the purchase of agricultural requisites, though often combining these functions with that of the sale of produce. But even here, Denmark, conducting a considerable export trade, developed its marketing organizations on co-operative lines in addition to its highly organized system of supply societies; indeed it has been the model upon which many of the marketing organizations in the newer countries have been based. Leadership in agricultural co-operation has belonged to Germany and Denmark.

A general characteristic of the European co-operative movement is that both in its origin and subsequent development there has been a certain idealism which has given it a special vitality Thus, in Denmark, the movement was associated with a moral educational revival accompanied with the development of the people's high schools; in Belgium the co-operative organization had a basis of religious and social culture; in Germany the birth of the co-operative credit movement was largely a question of the social regeneration of the rural population. In most of these cases it started with the clubbing together of a small number of villagers to carry out a common object, whether it was the purchase or sale of produce, or the provision of credit. But, although built up upon this small foundation, the movement gradually assumed a different character through the consolidation of the small units into large federated organizations, the gradual centralization of control, and the development of many of the features of big-scale enterprise. Indeed, federation describes in a word the modern development of the co-operative movement in most agricultural countries.

The main divisions of the co-operative movement in Europe have been supply, production, marketing, credit and insurance. Other minor, but important, branches are the co-operative use of farm machinery, cattle breeding, the supply of electric light and power, the manufacture of potato meal and potato alcohol, forestry and fishing.

**Supply Societies.**—These have aimed at purchasing agricultural requisites in bulk at wholesale prices and delivering them to members at cost. They have been widely developed upon "Rochdale" principles, the goods being delivered to members at certain fixed prices and the profits of the societies being distributed amongst its members as a "dividend" in proportion to the gross amount of their purchases This principle applies in many European countries, though an exception is to be found in France, where the profits of the "syndicats" go to the formation of a reserve fund which belongs to the members equally, irrespective of the amount of their purchases. The tendency in the development of these societies is to federate the local distributive societies to central wholesale societies on the general plan of the British distributive movement.

In Germany, the pioneer society in the movement towards wholesale federation was the Haas Society at Insterburg, founded in 1871. This example was subsequently followed by the rest of Germany, membership of the provincial wholesales being usually confined to the local distributive societies. The first permanently successful federation amongst consumers' stores in Denmark started in 1884 with the formation of the Co-operative Wholesale Society of Denmark amongst the societies on Zealand (Själland), for the supply of farm requisites as well as ordinary household requisites. Four years later a similar wholesale society was started in the Jutland Peninsula, and in 1896 these two were amalgamated into one organization—the Co-operative Wholesale Society of Denmark. Since then it has made remarkable growth.

In Switzerland similar progress has been made. The Verband-Ost-Schweizerischer - landwirtschaftlicher - Genossenschaften was formed as a central society. The business was divided into two departments—the agricultural, dealing with seeds, manures, cattle food, etc., and the store department, dealing with household requisites The organization also undertook the sale of members' produce, though its supply side remains its more important function. In France, the local, and more particularly the communal, "syndicats agricoles," united in departmental unions, and these unions formed the starting point of larger organizations—the "unions regionales."

**Production Societies.**—Probably the most successful branch of productive co-operation is to be found in the dairy societies existing in large numbers in all countries in which agricultural co-operation is firmly established. Leadership belonged to Germany and Denmark. Switzerland, France, Holland, Belgium and some of the countries of south-eastern Europe have also made considerable progress. Ireland, too, was one of the most successful countries in developing co-operative creameries. (*See* CREAMERIES.)

Mention should be made of the bacon factories and egg and poultry societies, the former of which have been brought to a high degree of efficiency in Denmark. These are factories requiring a considerable amount of capital and provided with subsidiary plants for the disposal of by-products. They are usually financed by loans jointly and severally guaranteed by the members, and receive the pigs from members under contracts binding them to supply their whole output for a period of years. The individual bacon factories are federated in the National Federation of Danish Co-operative Bacon Factories, with head offices in Copenhagen. One of the most remarkable achievements of this co-operative organization is the improvement of breed which it has enabled producers to bring about. A close study of the requirements of the British market (the principal export market) combined with scientific pig [illegible] under the supervision of the Government and the National Federation of Co-operative Bacon Factories, has led during the last 40 years to an improvement in quality, without parallel in other countries.

**Marketing.**—To Denmark also belongs the credit of beginning co-operative marketing. The tendency was to establish strong central selling or export agencies of which local productive societies were members. The need for co-operation among the local co-operative societies gave the impulse towards the centralization of marketing, and the formation of provincial and ultimately national associations, but many difficulties were experienced before the structural development of the marketing organizations was complete. The turning point was reached when the principle of binding contracts for the supply of produce was adopted. Under this system the members of a local co-operative marketing association undertook to supply the whole of their produce to their society for a term of years. The term ranged from one to as many as 20 years. On this firm foundation it has been found possible to build up the modern organization which markets the greater part of Danish agricultural produce. The local units, having a democratic membership control, are usually federated to the central society on "commodity" lines, that is to say, the federation of local societies is usually concerned with one agricultural commodity or commodities of closely allied character. Members are paid for produce by an advance at the time of delivery followed by a distribution of the profits at certain intervals. The produce thus delivered is classified and graded at the headquarters of the association, and the initial payment is made on the basis of this classification. For the purpose of marketing, the produce is "pooled." These principles—contracts, commodity organization and pooling—form the basis upon which a great part of Danish

co-operative marketing is conducted, and have been widely copied in America, Canada, Australia and elsewhere

The benefits which agriculture has derived from the European co-operative system are many. By the centralization of purchase and of sale, considerable economies have been effected, not merely in consequence of the elimination of the middleman and of bulk handling of the produce, but by the removal of the powers of exploitation which buyers and sellers of agricultural [illegible] not infrequently exercised over unorganized farmers. In organized marketing, large-scale handling has enabled scientific grading and standardization to be carried out, which in turn has led to the production of standard grades of produce and standard breeds of live stock on the farms This again, as in the case of bacon, has led to a general improvement in the quality of farm produce, and has greatly added to the competitive strength of the central export associations in foreign markets. Their products have earned a reputation for uniformity and sustained high quality against which unorganized farmers have found it increasingly difficult to compete

**Canadian Wheat Pools.**—Canada affords some remarkable examples of the development of large scale co-operative marketing enterprise, of which the wheat organization is the most significant The Saskatchewan Co-operative Elevator Company originated in the widespread discontent which was felt by farmers at the growing powers of the elevator companies.

Alberta followed the lead of Saskatchewan by setting up the Alberta Farmers' Co-operative Elevator Company in 1913, and four years later this company was taken over by the United Grain Growers, Limited. The movement towards centralized marketing has undergone further important developments For the purpose of selling, an organization known as the Saskatchewan Co-operative Wheat Producers, Limited, was formed, with headquarters at Regina. Members of the company, who already form a substantial proportion of the wheat growers in the province, enter into a five years' contract to sell the wheat through the company. Very similar arrangements have been made in Manitoba and Alberta, the respective organizations being the Manitoba Co-operative Wheat Producers, Ltd , with headquarters at Winnipeg, and the Alberta Co-operative Wheat Producers, Ltd., with headquarters at Calgary. To complete the system of centralization only one step remained, namely, to unite the three provincial pools into one organization. This step was taken. The Canadian Co-operative Wheat Producers, Ltd., with headquarters at Winnipeg, was formed as the central selling agency for the above three producers' pools, and operated for the first time in respect of the 1924–25 crop. The handling of milk, butter and cheese, the marketing of wool, live stock, poultry and eggs, fruit and other produce by co-operative enterprise has also made considerable advance in Canada since the World War of 1914–18.

**Australian Wheat Pools.**—The co-operative wheat pools of Australia are an example of a somewhat different character, since they came into being as the result of direct State action in order to meet the abnormal conditions during the War. They have brought about a fundamental change in the system of marketing wheat in that country. The original scheme was compulsory. It was entered into by the Governments of the Commonwealth, the States of New South Wales, Victoria, South Australia and Western Australia for the purpose of realizing to the best advantage the wheat harvests of the respective States, and for making advances to farmers pending the realization. The scheme was first applied to the 1915–16 crop, and it was subsequently decided to deal with the succeeding crops on the same principle. The duty of realizing the crop was placed in the hands of the Australian Wheat Board, consisting of ministerial representatives of the Governments of the Commonwealth and the respective States, and one representative of the growers from each State.

In each State a local board or commission controlled the operations of the scheme within its area, and the local board effected all local sales, including sales to millers Under arrangements with the Australian banks made by the Commonwealth and State Governments, advances were made to farmers upon delivery of their wheat at railway stations to the appointed representatives The proceeds of the wheat sales were applied, as realized, in reduction of the bank over-drafts which had been used for the payment of advances and expenses In 1922 the compulsory pooling of wheat was abandoned, but the principle of pooling the exportable surplus was continued on a voluntary basis under the respective State Governments Under this scheme, as in the case of the compulsory scheme, each State ultimately received, in respect of the grain actually shipped, the average net profit from the overseas realizations, which, after paying expenses, was distributed *pro rata* amongst the growers.

Mention must also be made of the rapid growth of agricultural co-operation in India, which has mainly taken place during the present century. Indian co-operation bears a much closer resemblance to European than to the American or Australian systems As in Germany, it has been developed largely to provide credit (and insurance) facilities, and to a limited extent for the purchase of requisites and the sale of produce. (X.)

## THE UNITED STATES

For more than half a century farmers of the United States have been actively interested in the co-operative way of doing business. As early as 1870 and in isolated cases even before that, farmers in this country were banding themselves together into local groups and were marketing farm products, purchasing farm supplies, and providing themselves with farm business services on a co-operative basis. The first broad expansion in the development of co-operative organization in this country occurred under the stimulus of the Granger movement, which reached the peak of its activity during the early '70s Later, further stimulus was given to the movement by other farm organizations such as the Farmers' Educational and Co-operative Union, the Farmers' Alliance, the American Society of Equity, and more recently, of course, by the American Farm Bureau But, generally speaking, agricultural co-operation as it has developed in this country represents a movement separate and distinct from the general farm organizations. It is wholly an economic movement concerning itself primarily with the marketing of farm products, the purchasing of farm supplies and the providing of farm business services on a co-operative basis.

During its early years the movement was beset by many failures of the local associations, chiefly because of the [illegible] practices. Much has been done to correct these weaknesses Sounder business practices have been adopted and operating policies have been changed from time to time to meet changing economic conditions. The co-operative principles, however, remain much the same today as they were 50 years [illegible] democratic control, limited returns on capital, and distribution of savings on a patronage basis still remain the dominant features of co-operative activity in this country. Agricultural co-operation in the United States has made its greatest gain since 1915. No other period of similar length in the history of the movement has given rise to as many associations as were formed during the years 1915 to 1921. In 1921 more than 12,000 associations, scattered throughout the United States, were in operation Since that time, the number of active associations has declined slightly, but with a definite trend toward the formation of large-scale associations operating on a State-wide or regional basis, membership and volume of business has continued to expand. In 1939, almost 11,000 associations reported an aggregate membership of 3,300,000 and a grand total business of $2,100,000,000.

In the United States, co-operatives have developed largely along commodity lines and the status of the movement can best be described by treating it in this manner.

Dairy Products.—In volume of business and in number of members, dairy co-operatives lead all other commodity groups. Scattered throughout 45 States are more than 2,400 dairy co-operative organizations selling milk, cream, butter, cheese and other dairy products for almost 750,000 farmers. Approximately 48% of all the fluid milk, 39% of all the butter, 25% of all the cheese and lesser amounts of other dairy products pass through the control of co-operative marketing organizations at one stage or another as these products move from farm to consumer.

**Livestock.**—The co-operative livestock marketing associations may be divided roughly into two groups: (1) those operating primarily at terminal markets, and (2) those operating primarily at country points. The first group is composed of 43 large terminal sales associations with 12 branches operating on 42 of the larger markets in the United States. This group of associations handles about one-fifth of all the livestock sold at public stockyards The latter group is composed chiefly of local associations engaged primarily in assembling and shipping. In 1940 there were about 850 associations of this type in operation. A few of the local associations do their own selling, but the large majority of them consign the livestock to commission associations on the terminal markets.

**Grain.**—Co-operative grain handling facilities, which vary from inexpensive portable elevators to million-bushel terminals, are to be found in nearly every section of the nation where grain is produced on a commercial scale. These facilities are the property of more than

2,600 grain co-operatives which in turn are owned by 360,000 farmers. The typical local elevator has a membership of 100 to 200 persons, each of whom owns one or more shares of stock in the organization. Grain is received from both members and non-members and generally the prevailing price is paid at the time of delivery. Likewise, farm supplies such as feed, fertilizer, coal and machinery are sold at "going" prices. Any earnings or savings made by the association are later distributed as patronage dividends on the basis of the volume of business transacted. Many of the local elevators hold membership in large regional sales agencies through which much of the grain is marketed.

**Fruits and Vegetables.**—In all of the important commercial growing areas, producers of fruits and vegetables have developed co-operative marketing associations. More than 1,100 associations located in 45 states are now (1940) in operation. The greatest development has occurred in producing areas farthest from the large eastern markets. California, Florida, Colorado, Oregon and Washington are the leading states. Approximately 60% of all the citrus produced in this country is marketed by co-operative organizations. More than 180 associations, scattered over 33 states, are marketing potatoes. Apples coming mainly from the Pacific northwest, the Shenandoah valley, and the commercial areas of Michigan and New York, are handled by 78 associations. Strawberries from Louisiana, Missouri, Arkansas, Kentucky, Virginia and other commercial areas are placed on the market by 125 co-operative associations. Many other fruits and vegetables are handled in substantial volume by co-operative organizations. Some of the more important of these are grapes, prunes, peaches, pears, beans, celery, tomatoes, lettuce and asparagus.

**Cotton.**—Co-operation among cotton farmers in this country has developed along three distinct lines: (1) cotton marketing associations, (2) cotton gins and (3) cottonseed oil mills. Fifteen large-scale centralized marketing associations, most of which are operating on a state-wide or regional basis, report an aggregate membership of 280,000 cotton farmers, and during recent years have handled from 1,500,000 to 2,000,000 bales of cotton annually. The cotton gin movement has reached its greatest development in Texas and Oklahoma where 20% to 25% of the crop is ginned through farmer-owned and farmer-operated plants. The movement is gradually spreading to other cotton states and at least a few co-operative gins will be found in Mississippi, New Mexico, Arizona, California, Louisiana and Alabama. Newest of the cotton co-operative enterprises are the cotton-seed oil mills. By 1940 there were six in operation. The first of these was organized in 1922 and has operated continuously since that time. Of the other five, two were organized in 1934, two in 1937, and one in 1939.

**Wool.**—Approximately 50,000 farmers and ranchmen, scattered throughout the United States, are marketing wool co-operatively. The greater part of the wool marketed co-operatively is handled by 25 to 30 large-scale centralized associations which operate on a state-wide or regional basis. These co-operatives assemble, grade, warehouse and sell the wool for their members. Much of the wool handled by this group of associations is marketed through the office of the National Wool Marketing Corporation of Boston. The remainder of the associations are mostly local wool pools. Generally these organizations are small and often serve but a single county. In most cases they are informally organized and frequently are inactive except for a month or two at shearing time The wool is assembled and sometimes is offered for sale to the highest bidder, sometimes consigned to another co-operative, and sometimes sold direct to the mills.

**Poultry Products.**—The principal business of some 200 associations is that of marketing eggs and poultry for 100,000 farmers. In addition to these 200 associations, approximately some 700 other co-operatives are handling poultry products as sideline enterprises. Chief among these are a number of local co-operative creameries located, for the most part, in the middle western states. In the far western states of California, Oregon, Washington, Idaho and Utah where intensive commercial poultry production has developed on a large scale, poultrymen now own and operate some of the world's largest egg, poultry and turkey marketing associations. At least eight associations located in this area transact an annual volume of business in excess of $1,000,000 each. In the eastern states, where producing areas lie within easy reach of large consuming centres, the auction method of selling eggs and poultry has become very popular. In this area 26 egg and poultry auctions are now in operation. All of these have been organized since 1930.

**Other Farm Products.**—More than 15,000 farmers located mainly in California, Oregon, Georgia and Virginia are marketing nuts co-operatively. Eleven associations with a combined membership of 70,000 are marketing tobacco. Marketing hay is the principal enterprise of eight associations and a secondary enterprise for at least 40 others. There are 25 to 30 sugar beet bargaining associations. In the southern states there are eight or ten co-operatives manufacturing cane sugar. And one or more associations are handling each of the following products: maple sugar and maple syrup, honey, nursery stock, pulpwood, tung oil, broomcorn and fox fur.

**Farm Supplies.**—One of the outstanding developments in the field of agricultural co-operation since 1920 has been the rapid growth of purchasing associations From less than 1,000 associations in 1920, the number had increased to 2,600 in 1939. Volume of business increased from $50,000,000 to $335,000,000 during the same period. Membership has grown to almost 2,000,000 Many of the marketing associations handle farm supplies as a side line activity. Some of the fruit and vegetable associations supply their members with fertilizer, spray materials and packing supplies. Some of the dairy associations handle separators, milk pails, strainers and milk cooling equipment. Grain elevators quite generally handle feed, coal, salt, twine, hardware and other supplies for the convenience of their member-patrons

**Mutual Insurance.**—Farmers' mutual insurance companies, the first of which was organized more than 100 years ago, represent one of the oldest forms of co-operative activity in this country The primary purpose of this type of rural co-operative is to provide insurance on a cost basis. The 1,900 companies now active report an aggregate membership of 3,263,224 and a total of more than $11,000,000,000 of insurance in force.

**Mutual Irrigation.**—Located mainly in the western states are approximately 2,500 mutual irrigation companies. These are voluntary associations of persons engaged in producing farm products under irrigation. These mutual companies differ from the commercial companies in that they are operating on a non-profit basis, they differ from the irrigation districts in that membership and financial support are generally voluntary.

**Mutual Telephone Companies.**—Farmers' mutual telephone companies are now operating in every state in the union. Some 2,000 of these represent fairly large formally organized companies operating complete telephone systems including a switchboard. More than 30,000 others represent small informally organized groups of farm people who have pooled their efforts and constructed neighbourhood lines In many instances, these co-operatively operated lines provide the only telephone service available in the community and if it were not for them these communities would be entirely without telephone communication.

**Rural Electric Co-operatives.**—Among the newer undertakings by co-operatives is that of bringing electric power to rural communities. Since the Rural Electrification Administration was created in 1935, the number of farms in the United States provided with electricity has more than doubled. Much of this has been accomplished through the co-operative form of organization.

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*American Cooperation,* published annually by the American Institute of Cooperation, contains proceedings of the Institute.

(W. W. FE.)

**AGRICULTURAL CREDIT.** The credit needed in agriculture is of two kinds. The first is long term credit, required to facilitate land purchase or the execution of improvements; the second is short term or personal credit, required to finance the growing, harvesting or marketing of crops, etc. Systems of agricultural credit as they exist today in various parts of the world may be roughly distinguished according to whether they are based on a co-operative principle or not. Co-operative credit has been successfully developed in Europe (with the marked exception of Great Britain) and in India. In most of the newer countries co-operative systems have been relatively unsuccessful, and other means of financing agriculture have had to be found.

**Great Britain.**—There are very few British institutions specifically engaged in providing credit for agriculture, the bulk of farm credit being furnished by the joint stock banks and tradespeople, insurance companies and private mortgages. In regard to long term credit, two institutions (the Farmers' Land Purchase company and the Lands Improvement company) have, however, sought to specialize in this business. The former has aimed at lending money on mortgage for land purchase, but its operations have been on a very restricted scale. The latter, founded in 1858 and operating under special acts of parliament, has lent upward of £13,000,000 for the purpose of carrying out certain types of land improvement. Apart from these, farmers and landowners have mainly had to rely for long term loans on bank overdrafts secured by the deposit of title deeds and private mortgages. In regard to short term credit, for several years prior to World

War I attempts were made to establish co-operative credit societies in Great Britain on the Raiffeisen model (which had had such widespread success in Germany and other continental countries). In 1910 there were 31 co-operative credit societies in Great Britain with 663 members; during and after this war there was a substantial decline in their number and membership.

In 1922 the subject of credit was considered by a committee appointed by the minister of agriculture, and its report was published early in 1923. Its recommendations were adopted by the government, and the Agricultural Credits act 1923 was passed in July of that year. The objects of this measure were: (1) to enable persons who bought their holdings during the currency of the Corn Production acts (April 5, 1917 to June 27, 1921) when prices were exceptionally high, to obtain mortgage loans from the state repayable within a maximum period of 60 years; (2) to establish co-operative credit societies with powers to borrow from the state. The latter were based on limited liability, each member being entitled to hold any number of £1 shares upon which 5s. had been paid up, and to borrow in proportion to his share holding. The credit societies could borrow from the state £1 for each share so held.

Under the first of the above provisions, mortgage loans were granted to the gross value of £5,000,000. Very little interest was, however, taken by farmers in the formation of co-operative credit societies, only nine societies being actually registered under the act, of which four never commenced operations. In view of the small response to this measure, state advances to credit societies were discontinued in March 1927. Subsequently, the government stated its intention of introducing a bill dealing with this subject.

**Germany.**—Germany may be regarded as the birthplace of co-operative credit in Europe. The typical organizations have been the Landschaften or credit unions (for long term credit) and the Raiffeisen banks (for short term credit). The former originated as far back as 1770, and gradually extended not only in Germany, but to Denmark, Hungary, Russia, Poland, Norway and elsewhere. The basic principle was the issue by the Landschaft of bonds based on estates mortgaged in its favour—the bonds being secured upon the collective guarantee of the members of the Landschaft. The borrower was paid not in cash but in bonds which he could realize on the market. He had the right to repay by annuity or by special instalments, or to cancel the loan by purchasing and tendering bonds. Landschaften bonds were regarded as first-class securities, and during the period 1910–14 were quoted on nearly equal terms with the loan bonds of the empire. The principle of the Raiffeisen banks, which were empowered both to make loans and to take deposits, was originally that loans were secured by the collective unlimited liability of all the members. Limited liability was, at a later date, adopted by a small number of these societies. In some cases they added to their credit business that of purchasing supplies for the members, such as seeds, fertilizers, coal, etc. Under Raiffeisen's personal guidance the local credit societies were affiliated to central loan banks, which subsequently received assistance from the state. The wonderful growth of these societies into a vast banking organization, without incurring any serious losses, is perhaps without parallel in the history of finance. In 1924, out of 38,000 registered agricultural co-operative societies in Germany over 19,500 were rural banks.

The postwar inflation in Germany, involved the whole credit organization in acute difficulties, and with the collapse of the paper mark, confidence was destroyed and depositors ceased to lend their money. For these reasons German agriculture found itself faced with an extreme shortage of capital, interest rates rose to a very high figure and farm mortgages became, for a period, unobtainable. After the stabilization of the currency and the introduction of the rentenmark, drastic reorganization of the credit machinery became necessary. A central institution of agricultural credit, the Rentenbank-Kreditanstalt, an offshoot of the Rentenbank, was established, which operated through the previously existing credit institutions Ultimately, with the aid of loans raised in the United States, the situation was considerably relieved and rates of interest substantially reduced.

**France.**—The conspicuous feature of agricultural credit in France is the state subsidy which it carries with it. Under the Méline act of 1894 all or part of the members of one or more agricultural *syndicat* could constitute a credit society, whose capital was obtained by subscription of members. The credit society became a *filiale* of the *syndicat*. A considerable growth of these societies took place with the assistance of a voluntary organization which prepared model rules. In 1897 it was made a condition of the renewal of the charter of the Bank of France that it would place at the disposal of the state without interest 40,000,000 francs, together with an annual share in the profits of the bank, for the assistance of agricultural credit. In 1899 regional banks were created, the members of which were the local credit societies, and the above subsidy enabled the regional banks to reduce their rate of interest to the credit societies, and consequently to provide cheap credit to farmers. The number of regional banks in 1921 was 69, with nearly 5,000 credit societies affiliated to them. The extension of the system to the provision of long term credit was made under acts of 1910 and 1920, which permit a maximum loan of 40,000 francs to individuals to facilitate the acquisition and management of rural properties.

**Canada.**—In Canada credit unions have been more successful, and over 150 with a membership of more than 66,000 have been organized since 1906, mainly in Quebec and neighbouring provinces. By a number of acts the provinces of Canada have also sought to extend the facilities for short term credit to farmers. These include the Livestock Encouragement act, 1917, of Alberta, under which persons may form an association and jointly apply to the Livestock Commissioners for a loan; the Livestock Purchase and Sale act, 1913, of Saskatchewan; the Rural Credits act, 1917, of Manitoba, and a similar act in Alberta, both designed to promote co-operative credit. Mention should also be made of the Ontario Farm Loan act and the Agricultural Development act passed by the Ontario Legislature in 1921—designed both to assist land settlement and to provide short term loans. As regards long term credit, legislation has been enacted by the separate provinces. Manitoba passed Manitoba Farm Loan act, which became effective in 1917, and was subsequently amended in 1919 and 1921. The act established the Manitoba Farm Loans association, which serves as the lending agency between the provincial government and the farmers, and is governed by a board of five members including a Commissioner of Farm Loans. Loans are secured upon first mortgages on farm lands and are repayable by annual instalments in 30 years. Saskatchewan has passed legislation on similar lines (the Saskatchewan Farm Loan act, 1917), and Alberta has followed the general lines of the Farm Loan act in the United States.

**Australasia.**—The development of agricultural credit has received and is still receiving a considerable amount of attention in Australia and New Zealand. In most states of Australia state credit institutions, such as state savings banks, make a specialty of providing agricultural credit. A number of acts have been passed in recent years dealing with the subject of rural credit, among which mention should be made of the Commonwealth Bank (Rural Credits) act 1925 making provision for financing producers' organizations in marketing their produce. An account of these measures is to be found in the Australian Year Book 1925. In New Zealand a Royal Commission on rural credit published a report in 1926 which was followed by two acts of parliament, the Rural Advances act 1926 and the Bank of New Zealand act 1926, both designed to assist the development of long term agricultural credit.

**India.**—The development of agricultural credit in India has mainly followed the European model, and has made consistently steady progress. The first act legalizing co-operative credit societies was passed in 1904. This act was replaced by an act in 1912 which closely followed the English Friendly Societies act and permitted other forms of co-operation. The number of rural credit societies under this act exceeds 40,000 and these are mainly modelled on the Raiffeisen plan.

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## THE UNITED STATES

The past hundred years have seen a continuously increasing need in the United States for credit to finance farm operations, including the purchase and improvement of farm land and the production and marketing of crops and livestock. The increased cost of farm land, the use of commercial fertilizer, power machinery, and many other factors have contributed to increased credit needs. As a result a large percentage of farmers use credit. Farmers frequently have to go in debt to get in the farming business, either to buy equipment or land. To become landowners, most farmers have to supplement their savings with borrowed capital. The majority of farmers do not have sufficient working capital to supply their needs at all seasons of the year.

Rural credit, during the years in which farmers' credit needs were expanding, did not keep pace with the demand. Interest rates in some sections were abnormally high. At the turn of the century farm organizations and others interested themselves in the problem. Commissions were sent to Europe to study the farm mortgage systems in operation there. Finally, the congress of the U.S. passed the Federal Farm Loan Act of 1916, which provided for the establishment of a farm mortgage credit system. In 1923 provision was made for a system of federal intermediate credit banks which are wholesale credit agencies discounting agricultural paper. Ten years later, the Farm Credit administration was organized bringing together these and other federally sponsored credit services under one supervising federal agency. The Farm Credit Act of 1933 provided for a system of production credit, supervised by the Farm Credit administration, with local associations making loans directly to farmers and obtaining loan funds through the federal intermediate credit banks. This act also authorized the establishment of 13 banks for co-operatives under the Farm Credit administration to make loans to farmers' marketing, purchasing and business service associations. The Farm Security administration, the Rural Electrification administration and the Commodity Credit corporation also are sources of credit for farmers and farmers' co-operatives. Three states have operated rural credit systems but these were (1940) in liquidation. A number of states invest school and other funds in farm mortgages. The rural credit system thus includes commercial and private agencies, such as commercial and savings banks, insurance companies and individuals, supplemented with government-owned institutions and government-supervised co-operative institutions.

**Long-term Credit.**—Farm mortgage credit for purchasing farm land and making permanent improvements is used in much larger amounts but by a smaller number of farmers than credit for short-term production needs. The mortgage indebtedness of farmers in the U.S. was $3,200,000,000 in 1910. It increased during and following World War I to a peak of $10,800,000,000 in 1923. After 1923 it declined year by year to $6,400,000,000 in Jan. 1943. In 1940, 52% of the total was on farms in the 12 north-central states

The relative importance of different sources varies among the various regions. In 1943 important sources were the 12 federal land banks, $1,603,000,000; life insurance companies, $891,000,000; the land bank commissioner, $512,000,000; insured commercial banks, $471,000,000; Farm Security administration, $164,000,000. A large part of the balance was held by individuals.

An outstanding change in farm mortgage credit in the 10-year period, 1928–38, was the shift in sources of credit. The refinancing activities of the federal land banks and land bank commissioner resulted in large increases in outstanding loans of these agencies. On June 30, 1939. these two sources accounted for 37.4% of the farm mortgage debt of the country. Investment of life insurance companies in farm mortgages dropped from 22.9% of the total farm mortgage debt to 12.4% over the 10-year period, 1928–38 Joint stock land banks in 1928 holding 7% of the farm mortgage debt had liquidated their holdings to 1.1% on June 30, 1939.

**The Federal Land Bank System.**—Funds for farm mortgage loans were formerly brought into farming areas largely through banks. Selling farm mortgage notes in their original form became the usual practice. It was generally necessary to find a borrower who wanted a mortgage of a given amount, covering a certain period, and with definite terms. A system was needed which could standardize farm mortgages and hold them as collateral against which bonds could be marketed. The federal land bank system was established by the Federal Farm Loan Act of 1916 to meet these needs. The joint stock land banks, also established by this act and in 1928 holding a peak of $667,000,000 in farm mortgage loans, were placed in liquidation by the Emergency Farm Mortgage Act of 1933. The 12 federal land banks operated under the supervision of the Federal Farm Loan board until 1933, when the board was abolished and the banks placed under the supervision of the newly organized Farm Credit administration. The 12 federal land banks make long-term farm mortgage loans largely through national farm loan associations, local co-operatives, organized in the first instance by 10 or more farmers desiring loans totalling at least $20,000. In 1928 there were 4,500 to 5,000 national farm loan associations in the U.S. Consolidation of associations has resulted in a decrease in number to 3,484 active on Dec. 31, 1942. Each borrower subscribes to stock in the national farm loan association equal to 5% of his loan. The association subscribes to federal land bank stock. The 12 banks had a paid-in capital of $217,506,258 on Dec. 31, 1942. Of this amount, national farm loan associations owned $97,365,018, or 45%, and the U.S. government, $117,176,065, or 54%. About $3,000,000 was owned by direct borrowers.

Federal land bank loans can be made only to farmers or prospective farmers. No land bank loan may exceed 50% of the appraised normal value of the land plus 20% of the appraised value of the permanent insured improvements on the land. The maximum amount loanable is $50,000. The term may extend up to thirty-odd years. All loans are made on an amortized basis. Prepayment privileges are allowed after five years. Borrowers may deposit money in good years to meet instalments in bad years. Funds for making loans are obtained by the sale of long-term bonds. The 12 banks are jointly and severally liable for the payment of principal and interest on all bonds issued. The bonds are not guaranteed by the U.S. government. The interest rate on new loans may not exceed by more than 1% the rate borne by the last bonds issued. The contract rate on loans through national farm loan associations on Mar. 1, 1944 was 4%. This rate has been in effect from 1935. From 1917 through Dec. 31, 1943, the federal land banks made loans totalling $3,376,000,000. Federal land bank loans outstanding on Dec. 31, 1943, totalled $1,358,000,000.

**Land Bank Commissioner Loans.**—As a result of the collapse in farm prices, farm income and land values, thousands of farmers from 1932–35 were faced with foreclosure. Emergency measures were necessary. The Emergency Farm Mortgage Act of May 12, 1933, authorized the land bank commissioner of the Farm Credit administration to make farm mortgage loans of a more or less emergency character. These loans may be made up to 75% of the value of the mortgaged property but cannot exceed $7,500 to one individual. Funds for making loans are obtained through a government-capitalized institution, the Federal Farm Mortgage corporation, which issued government-guaranteed bonds aggregating $1,651,559,000 from its establishment in 1934 to June 30, 1939. Part of these funds were used to purchase federal land bank bonds. As the law stood (May 1946) the authority of the commissioner to make loans expired on July 1, 1946. From Aug. 23, 1933, the federal land banks have acted as agents in making and handling these loans. Some 613,000 commissioner loans, totalling $1,127,662,036, had been made to Dec. 31, 1943. Although a large percentage of loans were used for refinancing purposes, many young farmers have used these funds to supplement federal land bank loans for the purchase of farms.

The Farm Security administration makes first mortgage loans to enable a limited number of competent tenants, sharecroppers and farm labourers, unable to obtain credit elsewhere, to purchase family-size farms of their own and to make needed improvements on those farms. Loans may cover 100% of the appraised value of properties acquired but may not exceed $12,000. The rate of interest is 3%. Annual payments of interest and principal are 4.3%. To July 1, 1943, loans made aggregated $188,000,000. The Federal Housing administration is authorized to insure loans made to buy and improve farms or to modernize farmhouses and other buildings. Fifteen per cent of the amount of a loan must be used for materials and labour for new construction or repairs.

**Terms and Conditions of Farm Mortgage Loans.**—Marked changes have occurred in the terms and conditions of farm mortgages from 1917 when the 12 federal land banks first introduced the amortization principle into farm mortgage lending in the U.S. Prior to this, loans were made ordinarily for periods from five to ten years. As farmers were often unable to accumulate enough money to pay off a mortgage in that length of time the loan was usually renewed, entailing considerable expense. Following the lead of the federal land banks, most insurance companies and some commercial banks are making loans covering longer periods and often repayable on an amortized basis.

The trend in interest rates on farm mortgage loans was upward from 1917 to 1921, and then gradually downward from the early 1920s, except for a short period around 1930. Farmers in most sections were (1944) obtaining farm mortgage credit at the lowest rates ever available in the U.S. Federal land banks were making loans at a contract interest rate of 4%. The interest on instalments coming due prior to July 1, 1944, was payable at 3½%. Land bank commissioner loans were made at 5%, with all interest instalments maturing before July 1, 1944, payable at 3½%. The U.S. government reimburses the banks and the Federal Farm Mortgage corporation for the difference between the contract rate and the temporarily reduced rate. Interest rates of some commercial banks and insurance companies compare favourably with these rates in territories where they make most of their loans.

**Short-term Credit.**—It is estimated that from 60% to 80% of the farmers in the U.S. use some form of short-term credit each year. The largest source of production credit is commercial banks, which on June 30, 1943, had short-term agricultural loans outstanding totalling $1,316,385,000. Most country banks are either directly or indirectly affiliated with the Federal Reserve banks, which makes it possible for them to obtain short-term loans or rediscount eligible notes. Their loan rates vary from 5% to 10%. Credit advanced by merchants and dealers in farm products is usually much more expensive. Many farmers' co-operative buying and selling associations grant some credit to their members. Production credit associations with loans outstanding on June 30, 1943, totalling $256,991,000 are an increasingly important source of production credit. Since 1933, some 530 production credit associations have made production loans to farmers and livestock men. Twelve production credit corporations, one in each farm credit district, helped to organize, capitalized in part, and now supervise the local associations. Funds for making loans are obtained by discounting farmers' notes with the federal intermediate credit banks.

Each farmer-borrower owns class "B" stock in the production credit association equal to 5% of his loan. The capital stock of the production credit associations on Dec. 30, 1942, was $104,246,194, of which $21,989,942, or 21.1%, represented class "B," voting stock owned by 265.749 farmer-members of the associations and $82,256,252, or 78.9%, was class "A," non-voting stock held by the corporations, farmers and other private investors.

From Feb. 24, 1939 to March 1944, the rate of interest charged on production credit association loans had been 4½%. Prior to that date it was 5% but a reduction in the Federal Interstate Credit bank discount rate on the date specified enabled the associations to lower their rate.

Most loans are made on a budget basis. That is, a farmer arranges for his credit for a season and the money is advanced as he needs it. He repays the loan when the crops and livestock financed are sold. Interest is charged only for the time a farmer has the money.

In making production credit association loans careful consideration is given to farming plans and the ability of a farmer to repay a loan from the sale of farm products, rather than basing the loan entirely on the value of the collateral.

Another source of agricultural credit in a few localities is credit unions.

At times many farmers are unable to qualify for loans from banks and production credit associations. To meet the needs of this group, the United States government has provided emergency loans from appropriated funds or those advanced by government corporations. Under this heading may be grouped emergency crop and feed loans; loans made by the Regional Agricultural Credit corporations, and rehabilitation loans of the Farm Security administration. There were outstanding on Dec. 31, 1943, $107,600,000 of "emergency crop loans"; $40,000,000 of "drought relief loans" made in 1934–35, and $12,100,000 of "orchard rehabilitation loans." The Regional Agricultural Credit corporation was very active in 1932–33 and was revived to make emergency loans in 1943. Outstanding loans, amounting to $144,600,000 at the end of 1934, were down to $4,000,000 in 1942, but increased to $32,000,000 at the end of 1943. The Farm Security administration, developed from various relief activities among farmers in the middle 1930s, carries on a program with low-income farmers. On July 1, 1943, outstanding rehabilitation loans amounted to $380,300,000.

**Federal Intermediate Credit System.**—The 12 federal intermediate credit banks were established in 1923 under the Agricultural Credits act as wholesale credit institutions for agriculture, to provide production and marketing credit for periods longer than those ordinarily supplied by commercial banks. In 1933 these banks were placed under the Farm Credit administration and form one of the permanent units in each of 12 Farm Credit districts. The government had paid-in capital (Dec. 1942) in the 12 banks totalling $60,000,000, and they had accumulated earned surpluses of $20,400,000. Funds to lend are obtained largely from the sale of collateral trust debentures. These are not guaranteed as to either interest or principal by the U.S. government, but have been readily salable at low rates of interest.

These banks under the law are authorized to discount paper of any production credit association, bank for co-operatives, national bank, state bank, trust company, agricultural credit corporation, incorporated livestock loan company, savings institution, co-operative bank, credit union, or farmers' co-operative. Production credit associations accounted for about 75% of the loans and discounts of the intermediate credit banks in 1939. Loans to farmers' co-operatives through the Farm Credit system are handled largely by the 12 banks for co-operatives which use the facilities of the federal intermediate credit banks in obtaining part of their loan funds.

**Farmers' Co-operatives.**—The farmers' co-operative movement in the United States has shown large growth in the past 50 years. In 1937 a national survey gave the business of some 10,500 farmers' marketing and purchasing associations as exceeding $2,000,000,000 in a year. The capital of these associations is provided by farmer-member subscriptions and retains from the net proceeds of the products handled. Additional capital is often needed to supplement the association's funds in peak operating periods or to construct plants and to buy equipment.

To supply additional capital, farmers' co-operatives have a number of sources of credit. Commercial banks furnish a considerable portion of their credit needs. Beginning in 1923 the federal intermediate credit banks made loans to farmers' marketing and purchasing co-operatives on the security of commodities in storage. Since 1933 loans to co-operatives through the Farm Credit system have been handled largely by the banks for co-operatives which obtain part of their loan funds from the federal intermediate credit banks. The Agricultural Marketing Act Revolving fund, administered by the Federal Farm board from 1929 to 1933, provided funds for effective merchandising, facility, and commodity loans to farmers' marketing associations. Loans

from this fund were curtailed when the banks for co-operatives were established in 1933.

The 13 banks for co-operatives, one in each of the 12 Farm Credit districts and a central bank in Washington, D.C., make facility, operating capital and commodity loans to farmers' marketing and purchasing associations and to mutual companies. About 30% of the borrowings of marketing and purchasing associations outstanding at the peak period in 1936, according to the national survey, came from the banks for co-operatives.

The Commodity Credit corporation, organized Oct. 17, 1933, by executive order, provides funds for producers and farmers' co-operatives to finance the carrying and orderly marketing of certain agricultural commodities recommended by the secretary of agriculture and approved by the president. Loans authorized at a fixed rate per unit on basic commodities, such as cotton, corn, wheat or wool, may be obtained by producers through banks or other lending agencies on forms provided by the Commodity Credit corporation. The corporation also makes direct loans. Loans of the corporation outstanding on July 1, 1943, excluding loans held by banks and other financing institutions, totalled $218,535,000. The Rural Electrification administration provides funds to co-operative associations of users for financing the construction and operation of rural electric systems. On July 1, 1943, such loans amounted to $327,588,000.

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**AGRICULTURAL ECONOMICS.** Agricultural economics is the science which treats of the conditions, laws and institutions that affect the wealth-getting and wealth-using activities of farmers as individuals and of agriculture as an industry. Thus, it is concerned not only with the economic problems of the individual farmer in producing and marketing his products, and in financing his operations, but also with the economic aspects of the political, legal and other social relationships of farm people among themselves and with the rest of society, including the community, state and nation.

The scope of agricultural economics ranges, for example, from the acquisition, organization and use of the means of production on the individual farm to the broad programs and policies which affect the balance of all interests in the production, consumption and conservation aspects of agriculture. It includes, in addition, the study of the characteristics, behaviour and control of agricultural prices, the elements of cost in agricultural production, the problems of agricultural marketing, the methods of financing all phases of agriculture, the social and economic problems inherent in the ownership and use of agricultural land, the geography of agricultural production, and finally, the welfare of farm people as conditioned and determined by the foregoing aspects and by the size and distribution of farm population as related to agricultural opportunities.

Two methods of study have been used by workers in this field. The primary method has been to collect basic data regarding farmers, farms and institutions that serve rural people as well as more general economic data concerning agricultural subjects. As a part of this method, various research techniques have been applied to the data to ascertain those general principles which underlie the economy of rural people and institutions. A second method of approach has been to select from currently accepted principles of economics those considered helpful in the analysis of the problems under study. The two approaches, of course, have never been entirely separated and as the work has developed they have come to be more and more combined. Some studies have been confined to problems such as the economic organization of farms and of markets, while others have dealt broadly with issues involved in community, state, national and international policies which affect farmers, consumers or even entire populations.

The emphasis upon agricultural economics as a special phase of economics is based on man's dependence upon the products of the soil to meet his primary needs, especially for food, clothing and shelter, as well as upon the large number of people who are engaged in the occupation of farming. In fact, the basis of the most pressing problem among people throughout the world is man's relationship to the availability of food and other agricultural materials. Agricultural economic problems have become more acute with the development of commercial agriculture and the growth of the world's population from the beginning of the 18th century. The abundance of food produced in relation to population in some of the newer countries, including those of North and South America, Australia, New Zealand and parts of Africa, gave rise to problems of maintaining a profitable well-balanced agriculture based upon domestic and [illegible]. On the other hand, the pressure of population upon the food supply in densely populated countries, such as India and China, has been responsible for many social conditions peculiar to such countries. Primitive methods in such countries are largely the result of the scarcity of raw materials, land and capital goods, in relation to population. Under either set of conditions, the attainment of a balance between agriculture and the rest of the industry of a country and the development of international trade relationships which will enhance the well-being of the people are complex problems of major importance. Economic problems which have arisen from either a commercial or a subsistence agriculture have resulted in specialized research in agricultural economics.

Agricultural economics as a systematically organized body of knowledge is largely a product of the 20th century. In the United States, for example, following 1850, the invention of labour-saving machinery, improved transportation and communication facilities, and the bringing into cultivation of extensive fertile land areas rapidly expanded production to the point of burdensome surpluses. The amount of wheat production in excess of domestic needs in the U.S. at the end of the 19th century, for example, compared favourably with the total production of any European country. These surpluses, offered upon world markets, helped to disorganize the agriculture in European countries, and led to greater dependence upon the importation of food. With expanded grain production in some countries, improved transportation facilities and deficit food production in other countries, the comparative advantage among different countries led to increased specialization in production and to expanded world trade in agricultural products. The importance of these problems in both surplus and deficit countries naturally drew the attention of trained economists and technically trained agricultural workers interested in economics. It was in this setting that modern agricultural economics came to be recognized as an important agricultural science.

### EARLY CONTRIBUTIONS TO AGRICULTURAL ECONOMIC THINKING

Many references, both secular and religious, point to the importance of agriculture in the economic life of early people. In ancient Greece, knowledge pertaining to religion, ethics, law, economics and philosophy attained a degree of systematic treatment. Aristotle recognized the importance of the so-called art of money-making, and observed that husbandry and stock raising constituted the true and proper art of money-making, with the exchange of goods given a secondary place. Aristotle's recognition of man's dependence upon production, exchange and consumption, stands as one of the early recorded contributions to economic thinking. From the time the division of labour and exchange began to characterize organized society, agriculture has generally been accorded an important place in economic thought.

Some early Roman writers considered the revival and reform of agriculture to be fundamental in preventing the moral corruption of the nation. The economic importance accorded agriculture by the Romans is expressed by Cicero in the statement that "of all means of acquiring gains, nothing is better than agriculture, nothing more productive, nothing more pleasant, nothing

more worthy of a man of a liberal mind" Roman writers, Cato, Columella, Varro and Virgil, paid special attention to technical agriculture and rural economy; they opposed large estates, absenteeism and the spread of slavery, but praised small-scale farming. Pliny lamented that the large estates—latifundia—had brought ruin to Italy.

During the middle ages, 400 to 1300 A.D., much of the land of Europe was cleared and brought into agricultural use. The feudal system tended to provide for local self-sufficiency although goods and services were limited. Some new patterns of land settlement were undertaken, but there was a tendency for the agriculture to develop in similar ways. However systematic the thought of that period may have been, it has not contributed much lasting influence on present-day agriculture Monks and other members of religious orders which were large landholders studied the Roman writers. In the 13th century, Walter of Henley, in England, wrote a number of manuscripts on agriculture, which dominated the field until the 16th century when they were superseded by works on husbandry and surveying, in 1534, credited to John Fitzherbert. The gradual decay of feudalism from the early modern period opened the way for more systematic thinking regarding economic life and well-being

The place accorded agriculture in the economic life of a nation received major consideration at the hands of the French physiocrats under the leadership of Dr. François Quesnay in the 18th century. The physiocrats praised agriculture for bringing into existence a net product (*produit net*) and stated that if the order or laws of nature were followed nature would be found providential in meeting human needs. In fact, they regarded all other industry to be sterile and agriculture as the only new source of wealth, because agriculture was the only industry that produced more than was put into it in the form of labour and capital.

### AGRICULTURAL ECONOMICS IN THE 19TH CENTURY

**Great Britain.**—In the agricultural history of Great Britain, throughout the 19th century, there appeared much of the foundation upon which modern agricultural economics has been developed. In the classical school of economics, David Ricardo and Thomas R. Malthus deserve mention for their contributions of principles related to the economics of agriculture. Malthus took the point of view that nature instead of being munificent was niggardly, in the sense that population tended to outrun the food supply. Instead of looking upon agriculture as producing a net product, his theory was that as the supply of land became limited, man was forced to move to poorer and poorer grades of land. As this expansion in production became necessary, the best land produced a product above the cost in labour and capital required to produce the same amount of product on the poorer grades of land. Thus, he pointed out, in his essay on the *Principle of Population,* published in 1803, that, since population tended to increase by a geometric ratio while agriculture increased only by an arithmetic ratio, eventually population would tend to outrun the food supply. This would force man to operate successively lower grades of land except insofar as checks on population, such as famines and wars, retarded or reversed the trend. It was this theory in particular that gave Malthus and some of his associates the name of the "pessimists." His theory was developed when England was experiencing a shortage of food supplies at home.

Undoubtedly this theory was used by Ricardo in his development of a more complete explanation of rent. Ricardo's theory of rent, in brief, was that, with the growth of population, it became necessary to cultivate land of an inferior quality and that, as labour and capital were added to land in use, a reduced return was received for the added effort, or a diminishing return. Rent of land he regarded to be that share of the product of the soil which the landowner could charge for the use of the "original and indestructible powers of the soil." Land rent to Ricardo, therefore, represented the return from the better grades of land above that obtained from the labour and other costs expended on an equal area of low-grade land which produced just enough to attract labour and to justify the other costs incident to production. The extent of cultivation on the lower grades of land would be determined by the needs for food. He further recognized that the best grade of land would profitably absorb more labour and other costs than an equal area of low-grade land. Thus, Ricardo recognized both the intensive and extensive margins of cultivation. While many criticisms and refinements have been made, the contributions of Malthus and Ricardo, in pointing out the differential return from land of different grades, are fundamental in the economic theory of land rent, although the incorporation of capital in land makes it difficult to determine true economic rent. Among the criticisms should be included those made in the 19th century in the United States by H. C. Carey, F. List and F. A. Walker, and in Germany by J. H. von Thuenen.

The industrial revolution of the 18th century required marked adjustments in agriculture to meet the new conditions. As agriculture took on more of a commercial aspect, Jethro Tull, Charles Townsend, and Robert Bakewell introduced farming innovations which helped to meet the changing agricultural conditions. William Marshall, in his surveys of British agriculture, published in 1785, and Arthur Young, mainly in the next decade, as author and as secretary of the board of agriculture, deserve credit for careful study of agricultural practices and the development of a popular interest in agricultural economic problems. Marshall gave his book the title of *Rural Economy* and covered both agricultural practice and rural life The writings of James Caird, *English Farming in 1850 and 1851,* and R. E. Prothero, *The Pioneers and Progress of English Farming,* in 1888, analyzed the problems of the individual farmer and the relationship of farm profits to the well-being of the landlord and of the nation.

Great Britain, in common with the United States, Germany and other countries, felt the effect of the decline in prices of farm products following the end of the Napoleonic wars in the 19th century. As a result, in 1833, a parliamentary commission was appointed to study agricultural problems. This report found no magic solution for farm problems, but recommended changes in farm practice with special reference to farm leases to permit farmers to depart from specified crop rotations. This focused attention upon the need for adjustments in rent because of the uncertainty of prices, and upon compensation to tenants for unexhausted improvements which they had placed on farms and from which they had not received full benefit before they were required to quit the property. This was intended to induce tenants to improve the properties. Writings dating from 1650 had advocated legislative action respecting landlord-tenant relationships, but the bill introduced in parliament in 1850 entitled, "A Bill for the Improvement of the Relation between Landlord and Tenant in England and Wales," put the issue into clear perspective. An Agricultural Holdings act dealing with the relationships of landlords and tenants was passed in 1883 and was modified at intervals by later acts. This legislative action based upon practical local experience provided arrangements which tended to standardize and develop improved landlord-tenant relationships.

**Germany.**—In Germany, Albrecht Thaer occupied much the same place with respect to agriculture as did Tull, Townsend, Bakewell, Marshall and Young in England. He introduced new practices on his own farm; he published in 1798, a three-volume work on English agriculture, which was followed by further publications dealing with the fundamentals of agriculture. As a result of his work, the king of Prussia induced him to establish an agricultural school and experimental farm near Berlin. His interest was in the economic phases of farming as well as in the physical and biological problems. One of his students, Johann Heinrich von Thuenen, gained recognition for his presentation of economic considerations in determining the crops which farmers should grow under varying conditions of soil, transportation and markets. In *Der Isolierte Staat,* published in 1826, he criticized and refined Ricardo's theory of rent, pointing out that rent resulted because of location and relative transportation costs as well as from gradations in the productivity of land.

By the close of the 19th century, the more important German universities were offering courses in the field of agricultural economics. From the standpoint of emphasis, one could divide the professors of agricultural economics in Germany into two groups:

those who approached the field from a background of political and social economy, and those who were trained primarily in the technical phases of agriculture. An exception was Freiherr von der Goltz at the Agricultural College of Bonn, who included in his instructional work the history of agriculture, farm accounting, the economics of farm management and the political economy of agriculture. Von der Goltz deserves attention for his attempt to round out the field of agricultural economics, treating the economic problems which the farmer meets in his farming operations, as well as those which affect him but are beyond his immediate control.

German thought continued to distinguish between what might be termed farm management (*Betriebslehre*) and agricultural policy (*Agrarpolitik*). The former refers to those economic principles of farm management which lead to maximum net profits from the operation of a farm; while the latter is concerned with providing an opportunity, under the assumed legal and social order, to all persons in agriculture in accordance with their skill and activity, and helping to remove barriers to or to establish procedures for the development of the agricultural industry as a whole. In addition to Von der Goltz and Von Thuenen, credit must be given Wilhelm Roscher, who published a book entitled, *Nationalökonomik des Ackerbaues*, 1854, and in later years to Max Sering for contributing to the basic principles which aided in the development of agricultural economics in the United States.

**United States.**—Economic problems of agriculture received increasing attention in the United States in the period 1880 to 1900. In general, this was a period of falling prices and of a rapidly expanding agriculture. The low purchasing power of farm products had been accentuated by the rapid development of railroads and improvements in farm machinery which led to a rapid increase particularly in the production of wheat, corn, hogs and cattle. This expanded production and resulting low prices coincided with a deflation in the currency. Because of inability to pay debts, and the large number of mortgage foreclosures, farmers sought relief through governmental action.

Attention was attracted to the economic difficulties of agriculture by the Grange and the Farmer's Alliance following 1870, and the efforts of the Populist party in 1892. Of this group, the Grange was most successful in securing legislative and administrative help for agriculture as evidenced by their early sponsorship of the Interstate Commerce commission, free rural postal service, food and dairy product laws and tax reforms which found their way into state and federal legislation.

Interest in agricultural economic problems was shown by the American Economic association in 1892 when it devoted part of its program to the farmer movements in northern states. In 1896, this group discussed questions pertaining to the rapid growth of tenancy, mortgage indebtedness, soil exhaustion through one-crop farming, migration of young people from farms to cities, rural free delivery of mail, extension of electric railroads in the rural districts and better educational facilities for farm people. The general conclusion of the economists at that time was that the solution of the farm problem depended upon suitable adjustments in farm economy by the farmers themselves rather than through government action. The gradual rise in prices during the early part of the 20th century, however, probably did more to improve the prosperity of agriculture than changes in the organization of farms.

In the early part of this period Henry George's book, *Progress and Poverty*, written in 1880, received marked attention although it probably had more effect upon governmental policies in Europe than in the United States.

George developed a theory that landowners held a monopoly because of the growth in population, and were able to demand increased rents which made workers poorer. There is evidence that he accepted the Malthusian theory of population and the Ricardian theory of rent rather literally, and concluded that the way to secure more equitable distribution of income was through the "equal right to the use of land." This he would obtain through taxing the value out of land and using the income from the tax to support all public activities. United States economists in general attacked the single tax on many grounds but George must be credited with sensing the impact upon farmers of the problem of paying for their farms each generation.

Prior to 1900, the major emphasis of the agricultural colleges and experiment stations in the United States was upon the physical and biological problems of agriculture. Some attention, however, was given to the questions of farm tenancy, costs of producing farm products and farmer co-operation in particular (*See* AGRICULTURAL CO-OPERATION.) Thomas F. Hunt, who, in 1892, first offered a course in rural economics at Ohio State university, deserves special mention as a pioneer in the field of agricultural economics. This course, dealing with the historical as well as comparative agriculture, included lectures on Egyptian, Grecian, Roman, British and U.S. agriculture. Part of his course was devoted to practical farm management. His teaching influence was felt directly in the universities of Illinois, Ohio, New York and California. He was also an influential member of the American Association of Agricultural Colleges and Experiment Stations, and had wide influence in the introduction of the teaching of rural economics in the United States. In 1896 the course in rural economics was recommended by the association to be offered in all agricultural colleges while the outline for the course, adopted in 1900, was similar to that of Hunt's book, printed in 1899, entitled *Lectures in the History of Agriculture and Rural Economics*. In pioneering agricultural economic teaching, Hunt saw a place for economists and statisticians in agricultural colleges. While Hunt had much influence upon agricultural economics, because of his personal leadership, I. F. Roberts and F. W. Card came into prominence about the same time because of their contributions to farm management subject matter.

## DEVELOPMENT OF AGRICULTURAL ECONOMICS

**United States, 1900–1919.**—The beginning of the 20th century marks a convenient point from which to describe the development, scope and techniques employed in agricultural economics in the United States.

Teaching of agricultural economics in the state agricultural colleges, indicated by the names of the courses, began prior to 1900 in only eight states. Within the next 20 years practically every state college offered several courses in this field. The organization at these institutions of separate departments or divisions of agricultural economics, called by such names as rural economics, farm economics and farm management, as well as agricultural economics, began in 1904 at Ohio State university and now includes all of the agricultural colleges in all states. In many institutions, rural sociology is included as a division of agricultural economics, while, in some, rural sociology is a separate division of work.

Outside of these colleges, prior to 1920, the work of T. N. Carver, at Harvard, merits special mention. Carver was a trained economist with strong agricultural and sociological interests. Perhaps more than others of that period, he emphasized that all agricultural economic work should have as its goal better living for rural people in proper balance with the rest of society.

Early agricultural economics research in the state agricultural colleges was focused largely upon farm management. In 1902, W. M. Hays and Andrew Boss initiated cost accounting research in Minnesota. With gradual refinement, the work was continued there until temporarily interrupted by World War I. Shortly after 1910, detailed cost accounting studies of the entire farm business were developed especially in Illinois, New York, Ohio and Wisconsin, and later both complete farm cost accounting and enterprise cost studies were conducted in many states (*see* FARM MANAGEMENT).

At Cornell university in 1908, G. F. Warren developed the farm management survey type of study, a survey of the entire farm business. The first study was made of farms in Tompkins county, New York. This method of study was a major contribution to farm management research and became the basis of the method employed in much of the farm management research by the United States department of agriculture.

At Wisconsin some work was being done in cost accounting and farm survey records, but a much broader program was initiated

under the leadership of H. C. Taylor. Publications prior to 1919 reported studies at Wisconsin in farm credit, co-operative marketing, agricultural history, farm tenancy, land economics, prices of farm products and rural life, as well as farm management. In other institutions similar expansion was taking place.

Research in the farm management aspect of agricultural economics under the auspices of the United States department of agriculture virtually dates from 1902, when W J. Spillman became a member of the staff. Under his direction, studies were initiated to determine the way in which the best-paying farms were being managed, the relationships to surrounding conditions such as proximity of markets, the way of leasing or controlling the use of land, and the method of farming followed A separate appropriation for the office of farm management within the bureau of plant industry of the department of agriculture was made effective in 1905 Farmers' bulletins and other publications, prepared under the direction of Spillman, indicate that the work was quite closely restricted to the study of individual farms and farm practices until 1908.

Spillman and his associates contributed to an enlarged interest in studies in agricultural economics although major emphasis was given to farm records and bookkeeping. The work of the office of farm management was closely associated with the early agricultural extension work, which was established in 1914, under the Smith-Lever Extension act. C. B. Smith, who had been associated with Spillman in the office of farm management, became the director of the extension work in the northern and western states. Under him and his associates, the farm management demonstrations, based upon farm management survey records, was spread throughout these states in co-operation with the state extension services working through the county agricultural extension agents Interest in a practical system of farm financial and production records to be kept by farmers was developed in a number of states following 1914, particularly in Illinois, Minnesota, Nebraska and Ohio. Farm records practically displaced farm management surveys in extension work in 1917.

Federal work in agricultural marketing followed a development somewhat parallel to that of farm management and was initiated at about the same time. This led to the establishment of the office of markets in 1913. Especially to be noted among conditions which contributed to marketing problems in the United States were the long distances between centres of production and consumption, and the development of large-scale firms in various branches of the food industry. There was widespread feeling on the part of producers that something was wrong with the system of distribution. Reflected in political demands, it stimulated inquiry, first, by governmental agencies, then, by agricultural experiment station workers. The development of co-operative marketing and processing by farm groups made them more conscious of problems involved in market operations and gave stimulus to research.

In the U.S. department of agriculture, interest in marketing originated from two sources: statisticians and technical production men. The latter initiated commodity studies which laid the foundation for grade standards for various farm commodities. The office of markets, later becoming the bureau of marketing, emphasized systems of grading, standardization and inspection. World War I created interest in market information and a market news system was initiated. The rise in the cost of living developed interest in economic studies in this field and economists were brought into the federal work in marketing

One of the early contributions to the field of agricultural economics was the work done in agricultural statistics, dating back to 1867, when data were first collected on the production and yield of important crops. The names of N. C. Murray and L. M. Estabrook following 1900 are associated with the refinement of the crop and livestock-reporting service and extended the use of questionnaires mailed to farmers for collecting important statistics pertaining to agriculture These data, collected over a long period of time, have provided a basis for useful economic studies of agriculture.

Rapid development in the teaching, research, extension and regulatory phases of agricultural economics followed the organization of the American Farm Management association in 1910. At that time, a paper by K. L Butterfield, entitled "Analysis of Rural Problems," set forth the place of agricultural economics among other agricultural subjects Butterfield, in keeping with much of the thinking of that time, divided agricultural subject matter under five headings, as follows (1) the technical aspect. "farm practices," or "agriculture", (2) the business aspect: "farm administration," or "farm management"; (3) the scientific aspect: "agricultural science"; (4) the industrial aspect: "agricultural economics"; and (5) the community aspect: "rural sociology."

It is probable that the distinction between farm management and agricultural economics emphasized at that time was responsible for the delay in including the subject matter of farm management with that of agricultural economics. While the work of the American Farm Management association went forward steadily, a second group, which early took the name "agricultural economists," was likewise developing. In April 1913 a group of men interested in the broad field of agricultural economics called a conference known as the National Conference on Marketing and Farm Credits, and in 1916 the Association of Agricultural Economists was organized to promote the study and research of the various phases of agricultural economics, including agrarian legislation. In the organization and objectives of both this association and the American Farm Management association, one finds the problems in the field of agricultural economics set forth more clearly than previously. The formation of the American Farm Economic association, in Jan. 1919, marked the unification in the United States of the workers interested in the economics of agriculture.

Appropriations under the Smith-Lever act in 1914 provided federal aid, specifically for extension work in farm management, and paved the way for expanded work covering various economic problems as they became more evident following World War I Extension workers in contact with farmers rapidly became conscious of the varied economic interest of farmers.

In addition to those who have been mentioned in connection with early agricultural economic work, at least another group deserves recognition: C. J. Brand, B. H. Hibbard, E. G. Nourse, L. D. H. Weld, and others, who initiated marketing studies of an economic character and wrote extensively. At the same time, some technically trained agricultural workers initiated commodity studies, emphasizing the development of classes and grades of products together with their physical handling. An example of this is the work of H. W. Mumford and his associates which later became the basis for the federal standards for market classes and grades of livestock and meat.

Much research in marketing was done by private and co-operative business firms, particularly with respect to the demands for their products. One of the early notable books on co-operative marketing was published in 1914 by G. H. Powell, manager of the California Fruit Growers exchange. As a plant pathologist, he began studies of losses of citrus fruit in shipment and reached the conclusion that they could be prevented by improved methods of harvesting and packing. The formation of local co-operatives to perform these operations was an important link in the establishment of the California Fruit Growers exchange as an outstandingly successful co-operative marketing organization (*see* AGRICULTURAL CO-OPERATION).

Work in agricultural geography and history has been based largely upon the federal census of agriculture which first included farm production figures in 1840; acreage and values of farm property in 1850; land tenure data in 1880; farm mortgage data in 1890; and more complete information relative to land tenure, land use and other aspects of farm life from 1900 to date. Population data, from 1790, and occupational classification, since 1820, have been invaluable. The graphic presentation of data in the census volumes, developed first in 1880, has been of value in helping students to obtain fundamental information regarding the geography of and trends in agriculture. F. A. Walker was prominently associated with much of this development. Since 1900, census data

has been used extensively in presenting agricultural information historically and geographically.

Prior to 1920, land economics studies have been conducted at several institutions including the Universities of Wisconsin and Illinois. R. T. Ely, together with his associates at the University of Wisconsin, pioneered in the development of land economics. L. C. Gray for many years was the head of the early work in land economics in the bureau of agricultural economics.

While separate treatment is often given to rural sociology, it is included with agricultural economics in so many institutions and is so closely associated with it that it merits mention here. C. J. Galpin, while at the University of Wisconsin, pioneered in the study of the construction of the rural community in relation to trade centres, schools, churches and other centres of the community activities. The research projects in this field have emphasized the relationship of the individual and rural groups to institutional influences in their effect upon family and community lives.

A brief appraisal of agricultural economics in the United States, from 1900 to 1919, should emphasize the improved techniques of study and the systematic presentation of subject matter. Marked advance was made from abstract discussion and reasoning regarding agricultural problems to the adoption of the research method of analysis. Sound statistical methods and systematic economic interpretation of results led to widespread recognition of agricultural economics as a separate field of work.

It was the broadened interest in the economic problems of agriculture that led to the reorganization of the office of farm management of the United States department of agriculture in 1919. H. C. Taylor then became head of the office of farm management. The reorganization included seven divisions of work, as follows: cost of production, farm organization, farm finance, farm labour, agricultural history and geography, land economics and farm life studies.

**United States, 1919–1943.**—The 15 years after World War I were characterized by a growing demand for governmental action designed to bring relief from the low prices being received for farm products (*see* AGRICULTURE). The adjustment in the use of crop land to obtain food supplies needed during the war, and several years of large crop yields, left the U.S. with surplus grain for peacetime conditions. The postwar tendency was for Europe to develop a self-sufficing agriculture, while the accumulated surpluses in Argentina, Australia and other distant regions added to the available food supply as shipping became available. Farmers found, on the other hand, that new machinery, building materials, household goods, taxes, interest rates and other costs remained at a high level. Inflated land values, through 1920, led to the assumption of heavy mortgage indebtedness. Canada likewise met conditions similar to those in the U S.

Until 1925, agricultural production continued to expand with the perfecting of the gasoline tractor and large-scale machinery. Approximately 50,000,000 ac. of grass land were put into cultivation west of the Mississippi river in the United States, and extensive areas were added in Canada. Attempts to sell the increased production upon depressed world markets met both low prices and trade restrictions in European markets. In general, agricultural prices followed a downward trend until 1933.

The rapid development of improved highways and motor transportation started a revolution in marketing farm products following 1920. Trucking livestock to market stimulated the growth of smaller widely-scattered packing plants. Likewise. the truck made possible the expansion of whole-milk producing areas about cities and contributed to the establishment of larger creameries at central points.

Early legislative attempts to bring relief for low agricultural prices included the Federal Cooperative (Capper-Volstead) Act of 1922, the Federal Intermediate Credit Act of 1923, the Federal Agricultural Marketing Act of 1929, and the Smoot-Hawley Tariff Act of 1929.

The combination of low agricultural prices and revolutionary changes in marketing processes stimulated research in agricultural economics. In 1922 the federal work in farm management, markets, and crop and livestock estimates was further consolidated as the bureau of agricultural economics.

Research in this bureau followed lines which had been outlined in the reorganization plan of the office of farm management in 1919, and with increased emphasis on crop and livestock statistics and marketing. The research studies in marketing may be grouped under the four heads of (1) co-operative marketing; (2) commodity market operations; (3) special marketing facilities; and (4) research pertaining to regulatory problems. The first group of studies described and analyzed the development and problems of many types of co-operatives. The second dealt with inspection, grading and market services. The third included the reorganization of terminal produce markets, interstate trade barriers and the disposal of surplus farm produce. The fourth group of studies was conducted by various agencies, including the Federal Trade commission, the Tariff commission, the department of commerce, and some other divisions of the department of agriculture. Prominent among such studies were those of the grain trade and cotton trade.

Regulatory [illegible] the marketing of farm products experienced a [illegible] in this period in the administration of the Grain Futures act, the Cotton Futures act, the Packer and Stockyards act, and various warehouse developments —all of which were indicative of the forward steps being taken in the marketing and credit field.

During the same period, extensive discussion was given to measures designed to raise the level of farm prices. Prominent among the proposals were the equalization fee, the export debenture and the domestic allotment plans. Throughout this period the concept of parity prices for farm products was gaining in emphasis, although it did not find its way into legislative action until 1933. The results of research came prominently into the consideration of these legislative efforts. The expanding interest in and knowledge of the economic aspects of agriculture were reflected in the colleges and universities, especially the land-grant institutions in the direction given to research work, the heavy registration of students in agricultural economic courses and the broad program in agricultural economic extension.

The study of farm prices in relation to other commodities and the introduction of statistical and historical techniques of study were widely applied to agricultural economic problems in the period immediately following the close of World War I. In addition to the work initiated by Taylor in the Federal Bureau of Agricultural Economics should be mentioned that of G. F. Warren at Cornell university, although this work was rapidly expanded in many institutions.

The Purnell Act of 1925 made funds available for research in agricultural economics, home economics and rural sociology in the state agricultural experiment stations. These funds reached a level of $60,000 a year to each state in 1929, and gave rise to numerous research projects in the various phases of agricultural economics. Many state experiment station bulletins dealt with marketing and other economic problems of local importance, and furnished valuable material for teaching and extension. In addition, books, journal articles and federal publications have appeared pertaining to agricultural economics. The extent of the literature, from 1900, was exceedingly great.

Extension work in agricultural economics was sponsored jointly by the federal government and the state agricultural colleges following 1919. With the reorganization of the office of farm management, Taylor stimulated farm financial and production records for farmer use. The development of the account books adjusted to conditions in the respective states rapidly spread throughout the country. The University of Illinois was responsible for the development of the co-operative farm management associations sponsored by the University, but financed primarily by co-operating farmers. Similar co-operating groups have been formed in a number of states, particularly Minnesota, Iowa and Kansas. Economic outlook information for farmers, first sponsored in 1922 by the bureau of agricultural economics, is now an important extension project in practically every state. Likewise, marketing specialists within the states have given much time to

assisting co-operating farmers and organizations in the marketing of particular products

In addition to the agricultural experiment stations and state colleges of agriculture, much valuable work was done at Chicago, Harvard, Leland Stanford, Northwestern, Pennsylvania and other universities. Endowed research institutions, established following 1920, added impetus to agricultural economic studies. The Brookings institution at Washington, D C., while interested in broad economic studies, directed considerable study to agricultural problems The Food Research institute located at Stanford university, the Giannini foundation at the University of California, and the Farm foundation located in Chicago were primarily concerned with agricultural economic problems.

The deteriorating national economic situation following 1929 added to the misfortunes of agriculture, which continued to maintain a high level of production. There was unemployment and low purchasing power for farm products. It was this situation that led to the change of administration in 1933, to the agricultural phases of the New Deal. The tariff revisions in 1929 had brought little relief to agriculture. The disparity in the prices of the farm products and the goods and services purchased by farmers, together with the heavy mortgage indebtedness, resulted in the ruin of many farmers

It was the impact of these conditions that brought a number of important federal laws into effect. Among the more important of these are: the Agricultural Adjustment Act of 1933 with subsequent amendments; the Farm Credit Act of 1933; the Soil Conservation Act of 1935; the Agricultural Marketing Agreement Act of 1937; the Farm Tenant Act of 1937; and the new Agricultural Adjustment Act of 1938.

This legislative emphasis upon the economic problems of agriculture was paralleled by many studies pertaining to credit, market disposal, land tenure, land use, conservation of soil and the control of production. The controls over agriculture designed to rid the country of burdensome surpluses and to bring production into adjustment with demand continued until the outbreak of World War II.

The coming of the war found agriculture with abundant supplies of crops and livestock on hand, which enabled the farmers of the United States to greatly expand their production to meet the wartime demand. The war period brought an unlimited demand for agricultural products, leading to more attention to adjustments in the production and distribution of agricultural products to better meet national needs. After the outbreak of the war, emphasis was placed upon the production of maximum amounts of needed food per acre, per animal and per unit of labour or power. This period has led to many wartime organizations, including the Office of Price Administration, the War Food administration, Foreign Economic administration, Combined Food board and the United Nations Relief and Rehabilitation administration. These organizations, many of whose functions are economic in character, will not be treated here until their place, functions and accomplishments can be better appraised.

The period 1900–1919 marked a notable expansion in agricultural economics teaching, research, extension and regulatory work; the developments after that date were toward greater integration and toward work of a more vital character Within the agricultural colleges, teaching, research and extension in agricultural economics have become progressively more closely knit. Instructional and research subjects included farm management, co-operation, marketing, agricultural prices and statistics, finance, agricultural economic history, agricultural economic geography, land economics, rural sociology and agricultural policies. Agricultural labour, agricultural law, the appraisal of farm real estate and buildings, and rural government have received attention. Agricultural economics thus has drawn upon the various social sciences to make its contributions more practical.

**Great Britain.**—Following 1900 to the close of World War I in 1918, the general economists in the British Isles helped to refine the analysis of economic problems pertaining to agriculture. During this period little was developed of a statistical nature in the study of agricultural problems, but economic reasoning was applied to questions pertaining to policy, especially in the field of land tenure, marketing, land management and international trade.

In Great Britain, agricultural economics has had a somewhat different emphasis than in the United States. In agricultural economics research writings and teaching greater emphasis was put upon agricultural policies, although the problems of the individual farmer were continually stressed from a practical point of view.

The subject of agricultural economics was taken up by the ministry of agriculture and fisheries, but resources were limited prior to World War I. Assistance, however, was made available from the Development fund and from the University of Oxford An Institute of Agricultural Economics was established at Oxford. Its activities were, at first, directed to the improvement of farm accounts, especially by the use of the cost accounts. As further resources became available, its scope was broadened and important investigations were undertaken in other phases of the field. In addition to Oxford, Cambridge university and the University College of Wales took initiative in conducting agricultural economic studies. Also, agricultural economics was placed in most of the agricultural colleges of the British Isles by 1930, and the provincial agricultural agents were serving as economic advisers in their respective areas.

Following 1920 research was expanded to include marketing, especially with the formation of the Empire Marketing board. To quite an extent the agricultural economic problems in Great Britain, like those of the United States, were accentuated by World War II. As a deficit food country, the United Kingdom was in a better position to regulate trade in agricultural products than many other countries. Canada, Australia and Argentina, as well as the United States, continued to supply cheap wheat to Europe. The cheap feed supply encouraged the expanded production of dairy products in Denmark, Holland, Switzerland, Finland and New Zealand, and, in turn, contributed to low world prices for these products. Barriers to free trade in Europe tended to force uneconomic agricultural production adjustments within countries. The problems were accentuated by maladjustment in trade and delayed agreements concerning war reparation settlements.

In the United Kingdom various schemes for promoting production of agricultural products were undertaken. These included subsidizing the production of sugar, wheat and hogs, and the development of marketing schemes designed especially to stabilize the production of dairy products and hogs. The United Kingdom, dependent upon the importation of much of its food supply, sought to stabilize its domestic agriculture on a basis which would encourage production by providing definite quotas of agricultural imports. The Ottawa agreements, for example, provided for preferential trade in wheat and some other products.

The growth of interest in agricultural economic matters in the British Isles is reflected in the formation of the English Agricultural Economics society and in its published proceedings, as well as in the publications of the ministry of agriculture and fisheries, the Empire Marketing board, and in university publications.

**Selected Continental European Countries.**—Agricultural economics has attained more prominence in western European countries where the peasant populations supply farm products to industrial markets. To the east of these countries, that is, in the area between the Baltic, the Adriatic and the Black seas, there have been more pressing farming problems. After 1900 the increase in wheat production outside of Europe and, during the inter-war period, the fall in prices of farm products, the prolonged depression and, finally, the closing of markets for imported food products in western Europe, brought hardships to many countries, especially to those in eastern and southeastern Europe. These and other agricultural problems stimulated work in agricultural economics, especially in the more industrialized European countries.

Several of the larger countries on the continent of Europe have aimed at being self-sufficing in food. The service of agricultural economics in these countries has been directed to these social ends as well as to the development of better organization of farms.

**France.**—The land survey (cadastre), dating its modern phase from about 1790, has had continued development. Appraisal technique for farm properties, nurtured by a professional organization founded in 1838, has likewise had continued development. E. Jouzier gave impetus to economic studies through his *Economie Rurale* (1903). Agricultural policies have been the object of considerable research by French economists. French peasants, generally, have been indisposed to make available facts as to the results of their farm and investment activities. The virtual absence of farm accounting work has retarded economic research in France.

**Germany.**—Agricultural prosperity has been a goal of German statesmen since about 1870. The Bismarckian philosophy extended practically to the establishment of the Weimar constitution, 1919. A third main phase of German economic policy making began in 1933. In tariff and other protectionist policies, and other phases of study, agricultural economists were active prior to the Weimar constitution, reached a high development under it, and suffered considerable eclipse after 1933.

Influential in economic thought on German farm problems at the turn of the 20th century were T. von der Goltz, [illegible], M. Sering and others. Contributions to farm accounting, management and appraisal were numerous. Agricultural geography, history and policy were subjects of many treatises. The welfare of agricultural labourers as well as of tenants and landlords was examined statistically. Prior to 1933 there were many points of similarity in the breadth, depth and volume of scientific work in agricultural economics in Germany and in the United States.

Economic developments continued in German agriculture from 1933, but with considerable change in the personnel in governmental and university posts. The emphasis on self-sufficiency in foodstuffs increased under the nazi regime. The Food Estate (*Naehrstand*) was given control of farm and food problems. Upward trends in yields were a prime object in government policy. The land valuation services of the treasury were reactivated to provide a basis for adjusted tax rates promised the farmers for their support of the nazi program. Peasant holdings were made the object of hereditary farm legislation, affording some of the effects of the principle of entailing which had long been enjoyed by the estate farms in eastern Germany. Both under the Weimar constitution and subsequently, the political and economic influence of these large landholders continued with little disturbance. Rising land prices and other symptoms of effective protection to producers of farm products and holders of property continued into the World War II period.

Marketing as well as production and its land tenure basis came in for readjustment under the nazi regime. For example, boundaries were specified beyond which whole milk for table use might not be drawn into a city. Taxes applied to producers within the favoured area were used in part to reimburse those outside who must find other, usually less profitable, outlets. Perhaps, with the exception of Russia, the agricultural economy of Germany has undergone control more than that of any major country.

Recent contributions of German agricultural economists have been directed toward carrying out the administrative policies set by the national pattern. In general, new names appear as authors. These publications, however, show fewer comparisons of economic experiences within the country with those outside.

**Italy.**—By 1900, Italy had a background of scientific work on the land survey (cadastre) and in farm real estate appraisal methods extending back many decades. Creditable publications on land valuation were produced early in the 19th century, and other developed lines of agricultural economic work appeared toward its close. Prominent among economic theorists who made applications to agriculture was S. Iacini, about 1870. Also to be noted are G. Valenti, in agricultural statistics, and V. Niccoli (Milan and Pisa) and O. Bordiga (Portici), both of them university professors, who emphasized farm management, from 1900 to 1915.

Italian rural economy was in a disorganized condition at the end of World War I. It was then that A. Serpieri and other agricultural economists promoted the organization of the National Institute of Agricultural Economics and Statistics. In 1927, the work in statistics was taken over by the Central Institute of Statistics. Research centres of agricultural economics were established at Bologna, Florence, Perugia and Portici.

Agricultural economists in Italy have brought the points of view of history and sociology into their studies. They have given much attention to agricultural labourers, to land reclamation and to mountain populations.

**International Aspects of Agricultural Economics.**—International conferences have dealt with many economic problems in agriculture from 1864. A single product, sugar, received major attention for about 25 years. From about 1890 to 1942 international meetings, largely prompted by import and export problems, included more and more countries and more farm products Notable were the Chadbourne Sugar Plan of 1931 and the International Sugar Agreement of 1937. Rubber, in 1922, was subjected to the first operation of the Stevenson plan. In 1934 the International Rubber Regulation scheme was effected. No less than 16 international conferences were held in 1930 and 1931, primarily with regard to wheat. Under an agreement in 1933, a Wheat Advisory committee was formed which led, in June 1942, to the establishment of the International Wheat council, with provisions for semiannual sessions. In addition to efforts to bring about international regulation of production, exports and, to some extent, prices, international meetings have established world standards and grades, especially for cotton and wheat.

Apart from these farm commodity conferences, several types of agencies have promoted agricultural economic discussions at the international level. The International Commission of Agriculture called international congresses of agriculture. Beginning with the first session at Paris in 1889, 18 major sessions were held in 40 years. Relations between landlord and tenant claimed major attention at the Paris session. The second session, held at the Hague, 1891, is typical of the earlier meetings; it included seven sections, three of which were devoted to rural economy, credit institutions and legislative questions. In addition, some attention was turned to discussion of land nationalization, transportation of farm products and tariffs affecting agriculture. At Dresden, in 1939, there were nine sections which included (1) agrarian policy and farm management, (2) agricultural co-operative societies, (3) agricultural industries and (4) rural life and the work of the countrywoman. Both private and social economic emphasis has persisted in these farm congresses.

At the Budapest congress in 1896, David Lubin projected the idea of an international chamber of agriculture. The International Institute of Agriculture, founded at Rome, in 1905, realized a part of the goals included in the original project. Emphasis on agricultural economics gained impetus in 1933–35, when H. C. Taylor was the representative of the U.S. on the permanent committee of the institute. The institute has made outstanding contribution in its statistics and records of legislative enactments. The institute's efforts for a world agricultural census in the late 1920s, and again in the late 1930s, have had more than pioneering value. Numerous publications dealing with principal farm products on the world market and with broader problems of agriculture, as treated in *Agricultural Problems in Their International Aspect* (in co-operation with the League of Nations) (1923), and *World Trade in Agricultural Products* (1940), are of lasting economic value. The same applies to numerous articles in the *International Review of Agriculture*, one of the organs of the institute. In its library and other collections of data, the institute is unique.

The International Commission of Agriculture maintained several units. One of these was the International Confederation of Agriculture, and developed, about 1920, plans for separate biennial meetings in years in which the congresses were not convened. The confederation meetings for the most part have dealt with economic problems with which national farm organization leaders, primarily in Europe, have been confronted. The May 1938 report listed 14 international meetings in which economic aspects of agriculture were involved.

The International Federation of Surveyors has placed emphasis on valuation of farm real estate since about 1920.

The International Conference of Agricultural Economists was instituted in 1929 at Dartington hall, Devonshire, England. Subsequent sessions were held at Ithaca, New York, in 1930, Bad Eilsen, Germany, in 1934, Saint Andrews, Scotland, in 1936, and Macdonald college, Canada, in 1938. Published proceedings of these conferences show participation well divided between European and North American agricultural economists. Special publications on agricultural conditions in different countries of Europe appeared following the Bad Eilsen conference, and an *International Journal of Agrarian Affairs* was launched in 1939.

The United Nations Conference on Food and Agriculture, Hot Springs, Virginia, 1943, was followed by an Interim Commission on Food and Agriculture and provided for a permanent United Nations Food and Agricultural organization. The appraisal of the work of these agencies as of other agencies of the period of war and its aftermath is not to be made now (1944).

BIBLIOGRAPHIC NOTE:—In the United States, in particular, some of the more important current contributions are not included in books and are to be found through the use of bibliographic lists.

The United States department of agriculture has published in its *Bibliography of Agriculture* (monthly) current reference lists on agricultural economic subjects since July 1942. Similar current bibliographies were included, 1927–1942, in *Agricultural Economic Literature;* periodical articles and bulletins on economic aspects of agriculture have occupied a growing place in periodical indexes as *Agricultural Index,* 1915–date, *Bulletin of the Public Affairs Information Service,* 1914–date, and the *International Index to Periodicals,* 1913–date.

In its new series, also, the *United States Department of Agriculture Library Lists* and *Bibliographical Bulletins* include economic references.

Lists prepared in the division of bibliography, Library of Congress, 1900–1946, contain economic references especially for the period prior to the development of bibliographic services in the department of agriculture.

Agricultural economic bibliographies have been issued by various state and other institutions of research. To be noted is the *Wheat Studies,* Food Research institute, Stanford university.

The International Institute of Agriculture, Rome, published in English after 1938 an *International Bibliography of* [illegible] *Economics* (quarterly). This appeared, 1934–38, in *Berichte ueber Landwirtschaft* and was issued separately.

Lists of agricultural economic bulletins, periodicals and other publications of the national state and provincial departments of agriculture, the experiment stations and colleges and other institutions of research are available from the respective sources.

Among the many books that might be cited the following have been prominent and are representative:

United States: P. W. [illegible] and J. I. Falconer, *History of Agriculture in the Northern United States, 1620–1860* (1925); J. D. Black, *Agricultural Reform in the United States* (1929); T. N. Carver, *Principles of Rural Economics* (1911); A. A. Dowell and O. B. Jesness, *The American Farmer and the Export Market* (1934); R. T. Ely and G. S. Wehrwein, *Land Economics* (1940); G. W. Forster, *Farm Organization and Management* (1938); L. C. Gray, *History of Agriculture in Southern United States to 1860* (1933); B. H. Hibbard, *The History of Public Land Policies* (1924); E. G. Nourse, *Agricultural Economics* (1916) and *American Agriculture and the European Market* (1924); T. W. Schultz, *Redirecting Farm Policy* (1943); W. J. Spillman, *Farm Management* (1923); H. C. Taylor, *Outlines of Agricultural Economics* (1925, 1st ed., 1905); G. F. Warren, *Farm Management* (1913).

British Isles: A. W. Ashby, *Allotments and Small Holdings in Oxfordshire* (1919); R. E. Ernle, *Prothero, English Farming, Past and Present* (5th ed., 1936); C. S. Orwin, *The Determination of Farming Costs* (2nd ed., 1921); R. H. Rew, *A Primer of Agricultural Economics* (1927); J. A. Venn, *The Foundations of Agricultural Economics* (1938, 1st ed., 1923).

Selected Continental Countries: Friedrich Aereboe, *Allgemeine Landwirtschaftliche Betriebslehre* (6th ed., 1923); F. Aereboe, J. Hansen und T. Roemer, *Handbuch der Landwirtschaft* (5 vol., 12th to 15th ed., 1928–1930); T. A. L. G. von der Goltz, *Geschichte der deutschen Landwirtschaft* (2 vols., 1902–1903) and *Leitfaden der Landwirtschaftliche Betriebslehre* (vol. II, 7th ed., 1922); Etienne Jouzier, *Economie Rurale* (1903); Ernst Laur, *Einfuehrung in die Wirtschaftslehre des Landbaues* (2nd ed., 1930) and *Grundlagen und Methoden der Bewertung, Buchhaltung, und Kalkulation in der Landwirtschaft* (3rd ed., 1928); Kurt Ritter, *Der Getreideverkehr der Welt vor und nach dem Kriege* (1926); Walther Rothkegel, *Handbuch der Schaetzengslehre fuer Grundbesitzungen* (vol. 1, 1930; vol 2, 1932); Max Sering, *Die deutsche Landwirtschaft unter Volks-und Weltwirtschaftliche Gesichtspunkten* (*Berichte ueber Landwirtschaft,* new series, Sonderheft 50, 1932); Albrecht Thaer, *Grundsaetze der rationellen Landwirtschaft* (new ed., 1880); J. H. von Thunen, *Der Isolierte Staat* (3rd ed., 1930).

Nongovernmental periodicals giving prominence to agricultural economic materials include the following: *Jour. of Farm Economics; Jour. of Land and Public* [illegible] *Jour. of the American Society of Farm Managers and Rural Appraisers; Economic Geography; Proceedings of the British Agricultural Economics Society; Kuehn-Archiv* (since 1911), *Deutsche Landwirtschaftliche Presse* (since 1874), *Journal fuer Landwirtschaft* (since 1853), and *Landwirtschaftliche Jahrbuecher* (since 1872).

(C. L. ST.; H. C. M. C.)

**AGRICULTURAL EDUCATION.** Though agriculture is the oldest and greatest of industries, agricultural education in any organized form is among the recent activities of modern states. In Great Britain, or at least in England and Wales, it may be said to go back only to 1890. It would be untrue, however, to say that before then nothing was done. Chairs of agriculture and rural economy were founded at Edinburgh in 1790 and at Oxford in 1796; the Royal Agricultural college at Cirencester was established in 1840. But agricultural education provided in universities or colleges was beyond the reach of the bulk of the agricultural population. Little or nothing was offered to the children of farmers, smallholders and labourers until nearly the end of the 19th century. In 1890, the Local Taxation (Customs and Excise) act placed at the disposal of county councils a sum of money (popularly known as the "Whiskey Money," because it was derived from an increase of the taxation on spirits which was originally destined for another purpose), amounting roughly to £750,000 a year, and authorized them to apply it to purposes of technical instruction, including instruction in agriculture. From 1890 onward there was a considerable, if slow, increase both of the higher education provided by university departments of agriculture and agricultural colleges, and of instruction provided by county councils. By 1912 the state was granting £19,000 a year for higher education, and the English and Welsh county councils were spending £70,000 a year on the more elementary instruction. World War I stopped the development of plans already prepared for further expansion on a relatively large scale.

**Postwar Development.**—The present system, though it follows prewar lines in its organization, is largely the creation of the years since 1918. It falls into two main parts; the university departments of agriculture and agricultural colleges, whose distinctive mark is that they provide a long course, two years at least, usually three, leading to a diploma or degree; and the education provided by county councils, which is essentially an education of short courses intended for the boy or girl who is already working on the land and proposes to return to it.

Higher agricultural education in England and Wales (excluding veterinary education) is provided at 14 centres, of which seven are departments or schools of universities, and the other seven are agricultural colleges, each possessing its own governing body, and not forming an integral part of a university. Eleven of these institutions (all except the Royal Agricultural college at Cirencester and the two women's colleges at Swanley, in Kent, and Studley, in Warwickshire), discharge an important function outside the actual teaching of students. Each is an "Advisory centre" for a group of counties forming its "Province"; it is provided with specialists in the more important branches of science bearing on agriculture, such as chemistry and entomology, who supplement the more general advice provided for farmers by the technical staffs of county councils, and it acts as a unifying and co-ordinating influence for the experimental and advisory work of county councils. All the 14 institutions are recognized and aided by the state. The cost to the student varies considerably between the two Welsh colleges (Aberystwyth and Bangor) at one end of the scale and Oxford or Cambridge at the other end.

Education of a less elaborate character is provided by county councils; in some counties by means of a farm institute (a simpler and smaller agricultural college, usually possessing residential accommodation and a farm attached), in practically all counties through organized classes, held at no special institution, or through discussion clubs, evening lectures and similar less systematic methods. In 1927 there were 16 farm institutes, four in Wales (including Monmouthshire) and the remainder in England, all but one supported and governed by county councils. On the average they can accommodate 40 students each; the fees for board,

lodging and tuition vary between 17s. 6d. a week for students coming from the county which supports a particular institute to £2, 10s. od a week for other students. The main course at a farm institute is normally a six months' winter course in practical agriculture, extending from October to March, and designed for young people, from the age of 16 upward, who have been working on the land and are going straight back to it. During the summer months the institute is used for courses in dairying, poultry keeping and other special subjects The great majority of county councils, however, do not possess farm institutes, but attempt to take agricultural education to the landworker by such means as the organized day course (a continuous course of instruction held at regular times, usually one day a week, in any town or village where there is a demand for it, and extending over several weeks or perhaps months), evening classes, travelling dairy schools, courses for instruction in manual processes (plowing, hedging, ditching, milking, and the like), and lectures or demonstrations.

In 1937–38 the cost of the education provided by county councils in England and Wales was £420,000, of which the government provided a fraction over two-thirds and county rates the remainder. One other activity deserves mention. In 1922 the government started a scheme of scholarships in agriculture for the sons and daughters of agricultural workmen and of other rural workers in a similar economic position. Under this scheme approximately 100 scholarships are awarded every year, of which the great majority are short-term scholarships to farm institutes. The cost is £20,000 a year.

In Scotland, agricultural education has followed a rather different course, though it started on the same lines. The organization is not divided between universities and colleges on the one side and county councils on the other; the colleges control and direct the whole system. Apart from the small sums received as fees, the whole cost is met by grants from the state, which in 1925–26 amounted to £75,000. But in the education given, as distinct from the organization for giving it, the Scottish system resembles the English The three colleges in alliance with their respective universities provide long courses (three winter sessions) for the university degree or college diploma; they take the place of the English farm institutes by including in their curricula short courses for farming; and through the appointment of organizers resident in the counties they conduct extension work similar to that done in England and Wales by the staffs of county councils. Two special institutions should be mentioned: the Kilmarnock dairy school and the Craibstone School of Domestic Economy for Women, the former associated with the Glasgow college and the latter with Aberdeen.

**Other Systems.**—Broadly speaking, and with considerable variations due to differences of national character and environment, continental systems tend to fall into the main divisions already enumerated, of two or three years at universities or agricultural colleges; in the second place, there are short courses of a few weeks or months in the dead season, or of a year at most, at a residential institution—sometimes a college, more usually a farm institute or farm school: thirdly, miscellaneous courses, lectures, and demonstrations given by peripatetic instructors who endeavour to bring technical education to the farmer's door, or at least to his town or village. But there are one or two features of foreign systems which ought to be mentioned, if only by way of contrast to the British system.

Of these the most striking is, perhaps, the large part taken in Germany, Denmark, Sweden, and in fact nearly all over the continent of Europe, by voluntary societies and associations: in Denmark, for instance, agricultural societies own and manage many of the Folk high schools and support many agricultural counsellors—experts who combine teaching, lecturing and advisory functions. But the Folk high schools of Denmark are notable not merely as an example of voluntary effort, they are a great and successful attempt to add a finish to the education of the adult land-worker by giving him or her a six to nine months' course, not entirely agricultural and sometimes not agricultural at all, at a residential institution. In Belgium, a country of smallholders, there is a highly developed system of instruction for women and girls in a combination of practical agriculture and rural domestic economy; the system centres in the national institution at Laeken In Sweden also (besides the usual agricultural colleges, agricultural schools, and farmers' sons' schools, the last providing a three months' theoretical course for young men usually about the age of 22) there are something like 40 schools of agricultural economy for women.

**Changes in the British System.**—From 1924 or thereabouts two movements affecting agricultural education have gained prominence. The first is the movement for imparting into the ordinary subjects of instruction taught at rural elementary and secondary schools what is known as a rural bias—*e.g.*, arithmetic may be taught through simple farm accounts, or geography with at least some reference to the physical characteristics of the district in which the school is situated Provided it does not degenerate into a premature attempt at vocational training, there is everything to be said in favour of such a change.

The second change is a change of emphasis in the subjects usually taught in agricultural institutions and courses. Hitherto syllabuses of instruction have tended to be dominated by science, or rather sciences—chemistry, physics, botany A school of thought has arisen which starts from the fact that the farmer is not only a grower of crops, a producer of eggs or milk, a breeder of stock, but also a manager of labour, a buyer of goods, and a seller of products—in the ordinary phrase, a businessman. There is consequently a steady pressure toward modifying courses of instruction, particularly the short winter courses, by giving a larger place to such subjects as accounts (the foundation of business), the management of labour, and the elements of marketing technique. There can be little doubt that this side of agricultural education has been relatively neglected; but the teaching of management is not easy

**Defects in the British System.**—But though these changes may be beneficial, the British system still reveals several notable defects. First, it is far too small, not, perhaps, for the demands which are actually made on it, but for the demands which ought to be made. In the second place, the larger part of the English and Welsh system—the part organized and directed by county councils—is "patchy." There is no power to compel county councils to supply even the barest modicum of agricultural instruction, and accordingly the provision made for it in a county varies with the character and finances of the county council and its electorate. Thirdly, provision for the residential education of adults—one of the most marked and successful features of continental systems—is noticeably absent. Lastly, provision for instruction in manual processes and in the handling of machinery, though not absent, is not so common as it should be.

**Progress Being Made.**—Some of these defects are being slowly remedied. In spite of financial exigencies, college and county education does progress and grow; and, best of all signs, authorities are agreed that since 1900 there has been a remarkable change of attitude on the part of the agricultural community.

Farmers welcome the assistance of college and county staffs; and a first attempt has been made, through private enterprise, to provide at Avoncroft, near Evesham, an institution very similar to the Folk high school of Denmark for adult land-workers. If that experiment proves a success, it may be the beginning of a new era. Moreover, the education of women and girls has recently been investigated by a strong committee, which has surveyed the whole field; and the ministry of agriculture has put before county councils a detailed scheme for extending instruction in manual processes. In 1925–26 the number attending such instruction rose to 1,900—a number which, however small in itself, was at least an increase of 50% from the previous year.

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(H. E. D.; X.)

### IN THE UNITED STATES

Agricultural education in the United States finds its beginnings in the striving of individual landowners toward higher levels of production. This created interest and discussion in agricultural communities, induced the making of tests, trials and observations, pointed to the advantages of concerted action, and slowly but steadily laid the foundation on which present-day educational machinery was built

**Agricultural Schools.**—Among the early attempts to provide agricultural instruction in schools of less than college grade the following may be noted: In 1821 the state legislature of Maine granted to Robert Hallowell Gardiner an annual appropriation of $1,000 for the maintenance of an institute for agricultural and mechanic arts. The Gardiner Lyceum was opened at Gardiner, Me., in 1823. It employed a professor of agriculture, maintained a farm and offered short winter courses in agriculture. An agricultural school was founded at Derby, Conn., in 1826. So-called manual labour schools were established in New York state in the period 1825–40. They laid stress, in their curricula, on vocational training in agriculture and the industries. In 1845–50 several agricultural schools were founded, through private initiative, in New York and Connecticut. After the middle of the 19th century conditions became more propitious for the teaching of agriculture in elementary and secondary schools. A period of agitation was followed by the establishment of an agricultural high school at the University of Minnesota (1888). District and county agricultural schools were created a few years later, among them the agricultural schools in the nine congressional districts of Alabama.

By 1898 there had been established ten agricultural high schools. In 1909, there were 60 separate agricultural high schools. Agricultural courses were then being offered in 346 other high schools. Several states, among them Massachusetts (1911), New York (1913), Pennsylvania (1913), New Jersey (1913) and Indiana (1913) had established definite systems of vocational agricultural education.

It is estimated that in 1912–13 there were about 2,300 state agricultural schools, district agricultural schools, agricultural departments of high schools and ordinary schools that maintained systematic instruction in agriculture.

The Smith-Hughes Vocational Education act (1917) provides federal aid for vocational training, including the teaching of agriculture and home economics in secondary schools. Since the passage of this act many vocational agricultural schools, as well as agricultural departments of general high schools, have been established in the several states. Of the 11,561 rural high schools, 3,339 or 29% maintained vocational agricultural departments in 1927. They had an enrolment of 129,032 students. In that year there was available for the support of vocational agricultural education nearly $7,500,000, compared with about $740,000 in 1918.

The George-Deen act (1936) greatly increased federal funds and by 1942 a total of about $15,000,000 was being expended for 610,000 agricultural students. It may be noted, further, that many states have special laws which concern the teaching of agriculture in elementary rural schools.

**Agricultural Colleges.**—Simeon de Witt, surveyor-general of New York, published, in 1819, a pamphlet entitled *Considerations on the Necessity of Establishing an Agricultural College, and Having More of the Children of Wealthy Citizens Educated for the Profession of Farming.* A state agricultural college was established in New York in 1853. The oldest surviving state agricultural college is that of Michigan (1857). Similar colleges were established in Pennsylvania and Maryland (1859) and the incorporation of agricultural colleges authorized in Iowa and Minnesota (1858). The Federal Land Grant act (also called the first Morrill act) was passed in 1862. It created a group of state institutions of higher learning, known as the land-grant colleges and universities (*q.v.*). This legislation was far-reaching in its effects on the social and economic development of the country. The second Morrill act (1890), the Nelson amendment of the Morrill act (1907) and the Bankhead-Jones act (1935) provided additional funds for the state colleges. In 1936–37 the 69 land-grant colleges enrolled 21,254 agricultural students.

The state colleges and universities are intimately associated with the U.S department of agriculture This had its inception in the collection and distribution of seeds and plants by the patent office in 1839. The service was expanded to furnish information on various agricultural topics In 1862 the department of agriculture was organized as such and in 1889 its head became a member of the president's cabinet. When the Hatch act was passed (1887), funds were made available for the establishment of experiment stations as departments of the state colleges. Prior to that, state agricultural experiment stations had been established in Connecticut (1875), California (1877), North Carolina (1877), New York (1879 and 1882), New Jersey (1880), Ohio, Tennessee and Massachusetts (1882), Alabama and Wisconsin (1883), Nebraska (1884), and Michigan, Indiana, Kentucky, Maine and Minnesota (1885) A private sugar planter's experiment station was established in Louisiana in 1885, and state stations in Louisiana, Vermont and New Hampshire in 1886

In keeping with the provisions of the Hatch act, an office of experiment stations was organized in the department of agriculture for the purpose of maintaining contracts with the stations Subsequent legislation referred to as the Adams (1906), the Purnell (1925) and the Bankhead-Jones (1935) acts augmented the income of the stations, established better correlation of research on a regional and national basis and encouraged cooperation among the stations themselves and with the department of agriculture. The stations are primarily research institutions. As such they are maintaining many hundreds of research projects of direct significance to agriculture and the farm home, and creating a vast body of knowledge from which facts and generalizations are being drawn for the benefit of resident instruction and of extension teaching.

The Smith-Lever act was passed in 1914. It represents a national scheme of extension teaching in agriculture and home economics and is the culmination of a long series of local, state, regional and national efforts to stimulate agricultural progress by bringing technical and general information to the farm and farm home.

The antecedents of the Smith-Lever act include the almanacs, agricultural journals and newspapers, agricultural societies, boards of agriculture, farmers' institutes and demonstrations and lectures by public-spirited individuals. The act provides for county agents, home demonstration agents, club leaders and extension specialists. It makes the department of agriculture responsible for coordinating and supervising the extension activities in the several states. The work was further developed by the Capper-Ketcham act (1928) and the Bankhead-Jones act (1935).

The agricultural teaching, research and extension of the land-grant colleges and universities are being generously supported by the local, state and federal governments. In 1936–37 the federal government appropriated $17,256,207 for the support of agricultural extension, while the states, counties, farm organizations and individuals were expending for the same purpose $12,507,455.

*See* A. C. True, *A History of Agricultural Education in the United States, 1785–1925* (1929); W. H Shepardson. *Agricultural Education in the United States* (1929); Advisory Committee on Education, Staff studies on *Vocational Education* and the *Land-Grant College* (1938); E. D. Ross, *Democracy's College, The Land-Grant Movement in the Formative Stage* (1942). (J. G. L.; X.)

**AGRICULTURAL ENGINEERING,** broadly speaking, is the science of utilizing in combination the forces and materials of nature for the benefit of agriculture; specifically it implies an understanding of biology, soils science and agronomy, as a basis for the intelligent application of engineering principles to agriculture.

While agricultural engineering deals entirely with agriculture, it is related more or less to several other important branches of engineering, as, for instance, mechanical engineering, which has to do with the design and construction of steam and gasoline power units, railroad and factory equipment, and mechanical de-

vices generally. But agricultural engineering makes use of the principles here involved in the design of mechanical farm power units and machinery to perform the many and complex farm operations. It is related to electrical engineering, which has to do with the design and construction of electric power installations, transmissions and distribution lines, in that agricultural engineering puts the electricity to work on the farm in energizing electric motors to grind feed, milk cows, in providing current for electric fences and other equipment, and in performing some 200 other chores. It is related to civil engineering, which, among many broad problems, handles those incident to the extensive storage and arterial distribution of irrigation water and to the design and construction of large community drainage systems. On the other hand, agricultural engineering sees that the irrigation water is economically distributed and applied to crops and that in drainage the ditches and underdrains are scientifically planned to suit each field and the use to be made of the land. The civil engineer is also charged with the design and construction of large steel and concrete buildings whereas the agricultural engineer applies the principles of construction to the design of farmhouses, dairy barns and other animal shelters, storage facilities for farm crops, and miscellaneous farm structures and equipment.

It is generally recognized that the marked advance in agriculture since 1850, especially the great increase in convenience in doing work and the large reduction in labour per unit of production, has been due in no small measure to improved engineering practices and more and better machines. Thus the development of farm land from the wilderness by clearing, the control of erosion by terraces, the disposal of surplus water and the acquiring and regulating of the water needed for plant growth and for human and animal consumption are problems of the agricultural engineer. The erection of farm structures of all types, with their problems of light, heat, ventilation, etc., and the best use and design for the machinery and implements used in farm operations and transportation, as well as the sources of the power which operates them, also are in the field of the agricultural engineer In the United States this has been a natural consequence of a rapid increase in engineering of all kinds that came with the sudden opening up of great natural resources. In Great Britain and continental Europe, however, the scope of agricultural engineering is less specialized, the tendency being rather to give practical recognition to two distinct divisions of the science, dealing respectively with the mechanical phases (implements, machinery and power) and those of the soil (irrigation, drainage, erosion control, etc.).

Agricultural engineering as a profession got its start at Iowa State college, Ames, Iowa, where the first four-year course leading to a B.S. degree in agricultural engineering was established in 1905. Two years later the American Society of Agricultural Engineers was founded with a charter membership of 17. This number had increased to 1,300 by Jan. 1, 1944, mostly in the United States, but the membership includes citizens of Argentina, South Africa, Australia, Brazil, Canada, Colombia, Cuba, Ecuador, England, India, Mexico, Peru and Scotland. Before the outbreak of World War II there were members in Germany, Greece, Hungary, Netherlands, Norway, Panama, Sweden and Switzerland.

In the United States in 1941, 22 state agricultural colleges maintained courses leading to a degree in agricultural engineering, while several others, though they did not grant degrees, offered courses that constituted a virtual recognition of the science. In the United States, too, more than 100 agricultural engineers in various states were engaged in 1944 in full time extension activities—carrying to the farmer the results of agricultural engineering research in farm power and machinery, rural electrification, farm structures, soil conservation, and mechanical processing. Outside the United States, in 1941, the only degree course being offered in agricultural engineering was in Canada. In 1942 the only agricultural engineering education department in southern Asia was established at the Allahabad Agricultural institute in the heart of India.

The importance of agricultural engineering is further emphasized by the appearance in 1930, and each year thereafter, up to and including 1939, of the *International Directory of Agricultural Engineering Institutions* published by the International Institute of Agriculture at Rome, Italy. This lists the institutions of some 45 countries throughout the world which have studies under way dealing with agricultural engineering problems For each institution information is given regarding the exact address, scientific staff, research work in progress, equipment, publications which have been issued since 1932 and the languages which may be used in correspondence. (*See* also articles on AGRICULTURAL POWER AND MACHINERY; FARM BUILDINGS; RURAL ELECTRIFICATION; TILLAGE MACHINERY; HARVESTING MACHINERY; etc.)

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**AGRICULTURAL GANGS,** groups of women, girls and boys organized by an independent gangmaster, under whose supervision they execute agricultural piecework for farmers in certain parts of England. The evils of this system were so great as to lead to the passing of the Agricultural Gangs act (1867), forbidding the employment of any child under eight years of age, and of any female under a male gangmaster unless a female licensed to act as gangmistress were also present. Gangmasters must be licensed by two justices, and may not hold a liquor licence Later legislation made more stringent the regulations under which children are employed in agricultural gangs. By the Elementary Education act (1876), repealing and re-enacting the principal provisions of the Agricultural (Children) act of 1873, employment of all children under 11 was forbidden and restricted under 13. By the Education act of 1921, it is forbidden under 12 and restricted under 14. In 1940, in order to meet the exigencies of war, the provisions of this act were temporarily relaxed; local education authorities were, however, required to supervise the employment of school children, and to satisfy themselves in regard to hours of work, meals and other conditions.

**AGRICULTURAL INSURANCE.** Farmers have need for several kinds of insurance on property and on persons. Insurance contracts are made with farmers by (1) capital stock companies, (2) mutual companies or associations, (3) reciprocals or interinsurance exchanges, and (4) state or government funds or departments. Insurance on farm animals and growing crops is of types found only in agriculture. Risks involved have a different degree or character when in an agricultural setting; for example, farm buildings are usually isolated from the buildings of neighbours and are often remote from community fire-fighting facilities.

Insurance of farm buildings, crops in process of growth, livestock, motor-driven vehicles, and various items of personal property will be treated first in this article. Then will follow reference to employer's liability insurance, and health, life and various social security provisions.

**Fire and Lightning Insurance.**—Insurance equal to 75% of values of buildings and associated property items has been carried by many farmers against fire and lightning hazards. The amount of fire and lightning insurance in force on farms served by 1,885 mutual companies in the United States in 1941 exceeded $11,000,000,000. Farmers' mutual fire companies are numerous in the middle Atlantic and north central states, and in some cases are smaller in membership and in volume of insurance than is desirable. In southern states where the cost of commercial insurance is high and large percentages of farmers are uninsured,

there are few farmer-owned and farmer-controlled companies. Under some so-called perpetual policies, the amount of property insured may remain constant over long periods. Five-year terms are regarded as more desirable.

During the period 1914–35, the annual average cost of protection through mutual fire companies varied from about 23 to 32 cents per $100. About two-thirds of this cost was for losses and one-third for expenses. In some north central states annual costs were less than 20 cents per $100. Classification or rating of risks has been most common among the farm mutuals of the Pacific Coast states.

Rural fire and lightning insurance has long been established on a mutual basis in countries of continental Europe but to a less extent than in the United States. Commercial fire and lightning insurance has been a main dependence in Great Britain.

**Windstorm Insurance.**—Tornadoes and windstorms produced losses in the United States estimated at $35,000,000 annually from 1916 to 1935 In 1934 more than $3,700,000 of windstorm losses were covered by farmers' mutual windstorm companies. In the period 1900–35, operating expense varied from 3.5 to 8 9 cents per $100 insurance, an average of about 5 cents, while losses varied from 1 6 to 17.0 cents, an average of nearly 8 cents. Insurable risks include farm dwellings, most other structures, household goods, farm implements, livestock and farm products. A few companies provide that when a building falls or is materially damaged as a result of a windstorm, and fire ensues, the insurance is extended to cover the fire loss. Three-fourths of the companies in 1944 wrote policies for a five-year term, a small number for 8 and 10 years, and one-fifth wrote perpetual policies. A common practice is to write insurance at from 66⅔% to 80% of the total value of property. Since windstorm losses have been high on buildings poorly built for wind resistance, some companies classify risks and provide periodic inspection. Reserve funds of nearly 20 cents per $100 of insurance were reported in 1935, this being about half the desirable amount of reserve. About one-third of the farm windstorm companies carry reinsurance.

**Crops All-Risk Insurance.**—The first attempt at all-risk crop insurance was in Minnesota in 1899. Between 1917 and 1921 certain fire insurance companies introduced contracts for comprehensive crop-risk insurance. The first U.S. federal attempt toward crop insurance was under Title 5 of the Agricultural Adjustment act of Feb. 16, 1938. The Federal Crop Insurance corporation thus established provided all-risk yield insurance for wheat beginning in 1939 and for cotton beginning in 1942. During the 1943 crop season, about 13% of the wheat acreage and about 11% of the cotton acreage was insured, and the percentages of participating growers were about 30 and 10, respectively. The Agricultural Appropriation bill for 1943–44 provided that no additional insurance be written, but the power was restored in 1945.

The corporation failed in five successive years to collect premiums equal to indemnities paid. For the crop harvested in 1942, there was an excess of $22,000,000 of indemnities paid over premiums received. For three varieties of wheat insured, the premiums exceeded the indemnities, namely, white, hard red winter and hard red spring, but for soft red winter wheat indemnities were more than three times the premiums.

Under the crop insurance programs farmers were standing the first 25% (or 50%) loss in yield below the basic yield. In 1942 and 1943 an applicant could give a "commodity note" for the premium, which was expressed in bushels. Under this procedure the price was established at the maturity of the note, which was about harvest time.

The soviet union, under the law of July 19, 1934, developed two types of compulsory crop insurance. In addition to a specific risk insurance extended to many crops, there was provided an essentially all-risk insurance for a limited number of crops, mainly industrial crops, including cotton, tobacco and soybeans. This insurance did not cover low yield resulting from poor germination of seed and exhaustion of soil With a few exceptions, quantitative losses only and not impairment of quality, are insurable in the U.S S.R. The hazard of drought damage has been among the most difficult to cover

**Crops Hail, Frost and Flood Insurance.**—Hail insurance was begun in the United States in the 1880s among Connecticut valley tobacco growers and among farmers of North Dakota A state hail insurance department was instituted in the latter state in 1911 and the example was followed by South Dakota, Montana, Nebraska and Oklahoma. In 1919 hail risks estimated at $560,000,000 were carried by four state insurance departments, 41 mutual companies and 43 joint stock insurance companies.

High risk territory for hail damage is found also in the prairie provinces of Canada. In Saskatchewan the Municipal Hail Insurance association, organized under an act of 1912, carried $25,000,000 of risks in 1921 and 1922 The Hail Insurance district of Alberta was formed under the Municipal Hail Insurance act of 1918, and in 1919–22, $72,000,000 of risks were borne by its Hail Insurance board. These were reduced in later years.

In Europe, likewise, hail insurance has had extended use. Scottish Friendly societies are credited with having first provided hail insurance in the 1770s. In 1791 the Hail Damage society of Braunschweig, Germany, became the first continental venture In the early 1800s came French hail coverage by a society of mutual insurance. After the 1860s provisions for hail insurance were made in Russia, and later in Austria, Czechoslovakia, Denmark, Italy, Rumania, Sweden and Switzerland.

Frost insurance has been written for the protection of growers of sugar cane in Louisiana and citrus fruits in Florida and California. Insurance against fire damage to growing crops has considerable application both in North America and in Europe. The first known attempt to provide insurance against flood was in Austria in 1846. In general, flood insurance has not been successful. A limited indemnification for losses to crops and other property sustained from flood, earthquakes, windstorms, drought, etc., has been provided at public expense in Italy. The more comprehensive provisions of soviet Russia require contributions from the insured, with only specially favoured crops insured free of charge. Private associations in China have provided insurance against flood, drought and locusts.

**Livestock Insurance.**—There was a rapid growth of livestock insurance in the United States in 1919 and 1920 when meat prices were high. Thereafter such insurance fell to almost negligible amounts. Insurance of livestock in premises insured against fire and lightning is often included. Under the Farm Security administration after 1935, associations of clients were set up to insure life and property, and a veterinary group plan was adopted.

Mutual livestock insurance originated in Europe about the 13th century, primarily in Germany. France provides a leading modern example of European livestock insurance. Among 14,896 subsidized co-operative insurance and re-insurance societies in France in 1921, more than 10,000 were societies for livestock insurance. European experience has shown it to be more practical to insure large animals, such as cattle, than smaller animals such as hogs and poultry. Insurance of carcasses against condemnation by sanitary authorities has been adopted in some European countries. In Lithuania, under a law of 1938, a fund was set aside from government taxes whereby 70% of the value of livestock killed by lightning or by the collapse of buildings was payable to the farmers.

Insurance of livestock of exceptional value per head, as for racing, breeding, etc., has been widely applied in North America and Europe alike. Insurance of livestock while in transit to market is normally provided by the carrier.

**Farm Motor-Vehicle Insurance.**—Fire, theft, collision, public liability and property damage are important phases of insurance of automobiles and other motor vehicles used on farms. In 1936 a federal survey indicated that in the United States three-fourths of the farm families had automobiles and one-third of these carried automobile insurance. In New England, middle Atlantic, north central and Pacific regions, more than half were insured. There was little difference between farmers of high and of low income in the proportion of automobiles insured. The average automobile insurance premium paid by farm families was $22. There has been a lower accident risk for farm automobiles.

Farmers were maintaining less ample public liability and collision coverage. Trends after World War I were toward a higher proportion of farmers owning automobiles, trucks, tractors and other automotive items and toward a higher proportion insured. Insurance activities of farmers' organizations expanded the coverage in these fields. Under some state laws truck insurance was made practically compulsory.

Farm automobile insurance has been largely confined to commercial companies in countries outside of the United States.

**Employers' Liability Insurance.**—Farm operators with hired labourers are liable for employee accidents during time at work and when in transit to and from work, if the accidents are due to negligence of the employer. Employers' liability insurance is provided by farm mutuals and stock companies in the United States. In 1943 the annual minimum premiums charged farmers for workmen's compensation insurance and for employers' liability insurance were reduced in almost all parts of the country. Wartime use of emergency labour called for quarterly and even monthly insurance. An employers' liability contract with a reimbursement limit of $250 (or $500), for medical expense was developed for short-term employees.

**Personal Insurance.**—Members of farm families and others working on farms have need for personal insurance against loss of income or against increased outlays incident to (1) death (life insurance, burial insurance), (2) survival (old-age insurance, juvenile insurance), (3) impairment of health (accident and sickness insurance), and (4) inability to sell labour time (unemployment insurance). In areas of the United States surveyed in 1936, life insurance was held by only 43% of farm families. Many small policies had lapsed in the depression years preceding the survey. The average premium then shown was $72 a year. Among four life insurance companies showing lowest expense per $100 insurance in the United States in 1943 one was farmer-owned and farmer-controlled. In the period, 1936–41, there was a trend toward more [illegible] insurance. A 1941 survey indicated that 50% of the farm [illegible] carrying life, endowment or annuity insurance, and 11% health and accident insurance.

Protection against unemployment and against destitution in old age has been provided under national social security schemes in the United States since 1935, and in other countries for a longer period, but generally with little application to agriculture.

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**AGRICULTURAL LABOURER.** An agricultural labourer is a person, male or female, employed for wages by an occupier of agricultural land. In the United States and some other countries the term "hired man" is generally used. In Scotland the term "farm-servant" is the equivalent to that of "agricultural labourer" in England where the alternative term "farm-worker" is also in common usage. Conditions of employment vary widely. The contract of service may be by the day, week, the month, the half-year or the year. Remuneration may be wholly in cash or partly in cash and partly in kind. Census definitions of agricultural labourers vary considerably from one country to another, and comparisons of the relative importance of the wage-earning force in the various countries are difficult. In a few it is less than 20% of the persons occupied in agriculture, but in the majority of developed countries, it is between 20% and 40%. In Great Britain and the Netherlands it was as high as 60% before World War II. In Great Britain the status of the farm worker after World War II was almost identical with that of the wage earner in other industries, semifeudal relics having been discountenanced by trade union influence and by statutory wage regulation. (*See* AGRICULTURAL WAGES.)

In addition to agricultural labourers permanently employed there are large numbers of men and women who are employed as casual workers. They are employed for short periods, usually at piece rates, in seasonal operations, such as corn harvesting, fruit picking, hop picking, etc. One class of casual workers may be employed most of the year at various jobs in agriculture. Another class are townsfolk unskilled in farm work who go into the fields only at certain seasons, particularly during the harvesting of fruit, potatoes, etc. Machinery in some instances greatly reduced the demand for casual labour.

**Enumeration.**—Returns collected annually by the ministry of agriculture and the department of agriculture for Scotland from all occupiers of agricultural holdings in Great Britain show that in June 1939 there were 711,232 agricultural workers of whom 600,700 were "regular workers" (54,679 women and girls) and 110,462 "casual workers" (38,535 women and girls). World War II made heavy demands on farm workers as in other industries. In 1945, the farm labour force of Great Britain totalled 785,804 persons, of whom 611,092 were "regular workers" and 174,712 were "casual workers." But the "regular" male workers were 24,742 fewer than in 1939. To handle the increased output of the war years "regular" women workers were greater than in 1939 by 35,064 and "casual" workers were 64,250 more (32,291 women and 31,959 men). These figures for 1945 do not include the members of the women's land army, which numbered about 46,000, and prisoners of war, approximately 67,800 of whom were working on the land.

The "gang" system of seasonal labour which was notorious in the early part of the 19th century declined after the Gangs act was passed in 1867 to repress its abuses. During World War II groups of labour were employed and organized by the agricultural authorities of the counties to provide a mobile reserve for farmers who found themselves unable to overtake seasonal operations or for special jobs like draining and hedging.

There is a great variety of jobs to be done on farms, but specialization of labour has not been carried very far. The "skilled" farm worker is a man capable of undertaking not one but a variety of skilled jobs. Versatility and resourcefulness are distinguishing qualities in high-grade men. There are, however, certain main classes, most of them determined by the handling of particular kinds of livestock. The decennial census enumerates horsemen, shepherds, cattlemen, tractor drivers, general labourers, but on some farms there are other titles such as pigman, poultryman, thatcher and so on, which may in most cases indicate more of a special emphasis of their work rather than an exclusive occupation.

The housing of farm workers had become by late 1946 an increasingly difficult and controversial subject. Single men were housed variously in different parts of the country. With the great mobility of modern transport the old system of "living in" with the farmer was probably being displaced gradually by the men finding lodgings in the neighbourhood. There was said to be no substantial decrease in the "bothy" and "chaumer" system (common in Scotland and north of England), but where formerly the feeding of the single men was done by the farmers' kitchens, it is now increasingly done on a contract by wives of the married workers. A married worker may be provided with a cottage by his employer and the occupation of the cottage is conditional on the job. This is known as the "tied cottage." Otherwise, the worker may occupy a house in the neighbourhood which is not "tied" to any particular farm or employer. In the case of the "tied cottage" the farmer deducts the rent from the man's wage but under the statutory wage regulations the maximum deduction is fixed. Opposition to the tied house is that if a man changes his job for any reason at all his home is also upset; it puts him more at the mercy of his employer than in the

case of a man whose house is independent of his job On the other side it is claimed that farmers need to have certain men housed close to their work and to be able to get possession of cottages for men whom they themselves employ. The situation was obviously made more acute by the general scarcity of houses in rural areas. An official report in 1937 estimated that roughly 500,000 houses in England and Wales were occupied by agricultural workers, of which 200,000 were tied cottages. In Scotland the housing of married workers in tied houses was estimated at practically 100%.

**Social Insurance.**—Agricultural workers came under the National Health Insurance Scheme from the outset in 1910 and its subsequent developments under the acts 1911–41; the Old-Age (Non-Contributory) Pensions from 1908; the Widows' and Orphans' and Age 65–70 (Contributory) Pensions under the acts 1924–43, and the Workman's Compensation acts 1925–43. They were, however, excluded entirely from the Unemployment Insurance act of 1920 which extended state unemployment insurance to industry in general. Following a report in 1935 by the Unemployment Insurance Statutory committee, a special scheme for agriculture was brought into operation in 1936.

**Organization.**—The combination of workers for the advancement of their economic interests and particularly for collective bargaining with employers was later and less effective among agricultural workers than in other trades. In England, apart from a few spasmodic local efforts, the first organized attempt to establish an agricultural trade union was made in 1872 under the leadership of Joseph Arch. A National Agricultural Labourers' union was formed which in a short time enrolled about 70.000 members. Success was not maintained and trade union activity was negligible until the following century. In 1911 the National Agricultural Labourers' and Rural Workers' union was started and by the end of 1913 had a membership of nearly 12,000. The Scottish Farm Servants' union was established about the same time. The Workers' union also included an agricultural section. A substantial growth took place during and after World War I in both England and Wales and in Scotland. The establishment of the Agricultural Wages board and its county committees in 1917 was said to give the main impetus though statutory wage regulation in agriculture was not established in Scotland until World War II. Because of the difficulties of defining a farm worker and to the number of scattered workers to whom unions can offer practically no union contact, the proportionate strength of trade union membership among agricultural workers is difficult to calculate. In 1919, it was claimed that about half the agricultural workers were enrolled in trade unions, while in 1926 the membership was said to be not more than 6%, but the former figure, if based on figures of all officially returned farm workers, was grossly exaggerated. During 1946, agricultural workers were enrolled in the National Union of Agricultural Workers, the Transport and General Workers union agricultural section (with which the former Workers' union was amalgamated) and the Scottish Farm Servants' union, which in late years had been affiliated with the Transport and General Workers' union. The estimated membership of these totalled in 1946 approximately 170,000. (J. P. Mn.; H. C. M. C.)

**United States.**—The typical farm in the United States is a family farm, with the farm operator and his family providing all or a large part of the labour. In the harvest months of heaviest farm employment there is, for the country as a whole, only one hired worker employed for each two farms. The census enumerated 6,000,000 farms in 1945; for the three years, 1944–46, the total number of hired workers employed in agriculture varied from about 1,500,000 in January to about 3,000,000 in the peak months of July to October. The January number approximates the number of year-round hired workers.

With farms increasing in size, largely as a result of mechanization, there had been a decline in the numbers of both hired workers and family workers, the latter including farm operators and members of their families working without wages. For the country as a whole the decline was relatively greater for hired workers than for family workers. Numbers of workers employed in agriculture were reported as follows by the department of agriculture:

| | 1910–14 | 1935–39 | 1946 |
|---|---|---|---|
| | 1000's | 1000's | 1000's |
| Family workers | 9,160 | 8,352 | 7,864 |
| Hired workers | 2,892 | 2,568 | 2,148 |
| Total | 12,052 | 10,920 | 10,012 |

Numbers of hired workers declined more in the corn belt than in any other area of the United States. In Iowa, Illinois, Indiana and Ohio the number in 1946 was only 47% of the 1910–14 average. In contrast, the number of hired workers in the northwestern states of Washington, Oregon and Idaho was 31% higher in 1946 than in 1910–14: in this area the number of family workers also increased, by 29% from 1910–14 to 1946.

During World War II and the immediate postwar period farmers requiring hired workers had great difficulty filling their needs, and at greatly increased wage rates The composite wage rate per month, as calculated by the department of agriculture, was $96 40 on Oct. 1, 1946, compared with an October average of $30.20 in 1935–39, and $24 76 in 1910–14.

To assist in the recruitment and placement of workers a farm labour program was set up in the extension service at the beginning of 1943. This program provided a valuable service to farmers in securing both year-round workers and the large numbers of workers needed for short periods during harvest. In the first ten months of 1945 a total of 5,724,445 placements were made in this program, the number declining to 3,752,176 in the first ten months of 1946. To supplement the workers available in the United States foreign workers were also recruited, principally in Mexico and in the West Indies The extension farm labour program also placed World War II veterans as hired hands on farms, making 32,000 such placements in 1945 and 100,000 in the first ten months of 1946.

Farm labourers in the United States were in 1946 prevailingly unorganized. During the administration of Franklin D. Roosevelt there was some increase in their organization, particularly among migratory workers. The principal aims of organized farm workers were higher wages, better living conditions and amendment of the Social Security law to include agricultural labour.

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**AGRICULTURAL ORGANIZATION.** In most countries a growing realization of the weakness of the isolated farmer as a marketing unit and, again, of the dominance of industrial and commercial interests in modern legislation prompted the formation of farmers' organizations, in order to secure more adequate consideration of the position and needs of agriculture. The conditions of food scarcity brought about by World War I stimulated this movement. (*See* AGRICULTURE: A GENERAL SURVEY.)

Governments were obliged to deal collectively with the primary food producers, who on their side were forced into combinations to secure that the necessary regulations neither impeded production nor imposed an impossible burden on the farmers. Combinations for marketing are dealt with elsewhere (*see* AGRICULTURAL CO-OPERATION); the organizations here to be considered aim at uniting the farming community in order to influence legislation.

Further, since it has become clear that the status of the food producer can with difficulty be determined within the nation itself, considerable effort has been given to the formation of international associations which might be able to secure common action in the interests of agriculture. It is recognized that as regards the great staple articles of food, wheat and the other cereals, meat and dairy products, a common world price tends to be set, determined by the incidence of the exportable surpluses from the countries producing more than they consume, upon the chief open markets, *e.g.*, the United Kingdom. For example, the United States produces a certain excess of wheat beyond its requirements, which has to be exported chiefly to Europe. The price the American farmer will receive will be forced down by competition to the price obtainable in Europe less freight and

commission. This is, to take an analogy, the pressure generated by internal competition to sell, at which the safety valve blows off. The coincidence of other surpluses upon the European market or weakness in purchasing power there tends to lower the price; conversely the growth of a new demand, as from China and Japan, will enhance the price.

The tendency of commerce is generally to bring the run of prices of agricultural products, the output of which fluctuates from causes beyond control, continually down to the level caused by a surplus anywhere, a level which is on the average undesirably close to or even below the cost of production. Hence a general depression of the agricultural interest all over the world and an increasing tendency on the part of farmers to seek more remunerative occupation in industry or commerce. This is the justification for the attempts to create some international organization of farmers, however remote and impracticable common action may seem.

**National Organization.**—Examples of national organizations with legislative programs are the Union Suisse des Paysans, the National Farmers' union of England and Wales, the National Farmers' Union and Chamber of Agriculture of Scotland, and the Patrons of Husbandry (*see* GRANGE), the Farmers' Educational and Co-operative Union of America and the American Farm Bureau federation (*q.v.*) in the U.S. (*See* FARMERS' UNION.)

Perhaps the most notable agricultural organization in Europe from the point of view of influence is the Union Suisse des Paysans of which Ernst Laur was long the director. Organized in 1898, its membership includes nearly all the farmers of Switzerland.

The National Farmers' union was founded in 1908 and grew comparatively slowly until 1917, when it became necessary for agriculturists to have one organization to deal with the government in the campaign to increase food production. It is organized on a basis of county branches, each of which makes an allotted contribution to the central body. The union for Scotland was organized in 1938.

**International Organization.**—The International Institute of Agriculture (*q.v.*), as visualized by David Lubin, was created on the initiative of King Victor Emmanuel III of Italy in 1905. Its constitution was determined by treaty between the contributing states, and it was governed by a president and a permanent committee acting as the executive authority to carry out the instructions given by an assembly representative of the constituent states, sitting every two years in Rome, where the institute had its permanent home.

The representatives at the assembly and on the permanent committee were nominated by the respective governments; thus the institute was essentially a governmental organization, in which agricultural associations as such had no part. The work of the institute was of a technical character. It prepared an annual summary of the agricultural statistics of all countries and a digest of agricultural legislation; it also issued bulletins at regular intervals abstracting the papers appearing in the technical publications of the world on economic and scientific subjects connected with agriculture. The institute also convened from time to time international conferences on particular questions. In order to obtain an expression of international agricultural opinion that would be independent of governments the institute formed an association of representatives of agricultural associations of all countries, and the first meeting of this body was held in Nov. 1927. The associations invited to send representatives were, however, nominated by the governments of the respective countries.

Italy's entrance into World War II necessitated the withdrawal of the delegates representing the United Nations from the institute. With the founding of the Food and Agriculture organization of the United Nations in 1945 (*see* below), member nations of the U.N. who were also members of the International Institute of Agriculture agreed to dissolve the latter. All activities were assumed by the F.A.O., and the institute wound up its work on July 31, 1946.

The Commission Internationale d'Agriculture (later Confédération Internationale de l'Agriculture) a body founded in 1889, of which the chief task was the organization of the successive international congresses of agriculture, was eventually reconstituted in 1928 to consist of representatives of agricultural associations, not exceeding six for each country, and of co-opted members of distinction in agriculture, which latter might take part in the discussions but not vote. While the commission met twice a year in Paris, the resolutions to be communicated to governments were reserved for discussion at a conference held every second year in connection with the international congresses of agriculture.

The Food and Agriculture organization of the United Nations was created by the U.N. at the Hot Springs, Va., convention of May 1943 and was established as a specialized agency of the U.N on Oct. 16, 1945. The F.A.O., as mentioned above, took over the work of the International Institute of Agriculture, with headquarters in Rome.

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**AGRICULTURAL POPULATION, U.S.** As defined by the U.S. census bureau prior to the 1950 census, urban territory in the U.S. included all incorporated places of 2,500 or more. This definition was expanded for the 1950 census to include suburban areas around cities of 50,000 or more, and certain unincorporated places not previously included. Under this definition, 96,440,528 persons were classified as urban (60.4% of the total) and 54,256,833 as rural (39.6%). It was estimated that under the old definition of "urban," approximately 41% of the population would have been classified as rural in 1950. In 1940 about 43.5% and in 1930 about 43.8% had been counted rural.

**AGRICULTURAL POWER AND MACHINERY** The ingenuity of man has provided the farm with power and machines to make possible the necessary crop production in spite of the demand for labour in carrying on the world's other various and complex work. When industrial developments or simple trades grew up in cities and attracted labour from the rural districts, inventors soon began to improve the means of preparing seedbeds, cultivating, harvesting and simple processing on the farm or at places near by. This development was slow at first when manufacturing was small-scale and crude. Those were the days when plows were changing from natural wood forms to shaped wood and then to metal-shod wood, to metal and finally, to polished steel; the days when reaping equipment was changing from the back-tiring sickle to the back-tiring scythe and cradle; the days when man was slowly learning to save himself or his wife by using animal power—cattle, camels, horses and mules. Man and his beasts of burden provide much of the farm power in wide areas of the world, but the period following 1830, for 100 years and more, saw a steady change toward laboursaving and efficiency in agriculture, particularly in the United States and the countries of western Europe. After 1900 the tempo of farm mechanization had been greatly accelerated not only in the countries mentioned, but in other countries, notably in the U.S.S.R. following World War I. This trend reached into Australia and New Zealand, parts of South America, and into South Africa. The tendency at first in the adoption of farm power was to use tractors for the heavy work of plowing and the crucial work of harvesting where time is of unusual importance.

In many wide parts of the world the use of power and other modern methods of farming has not gone far. This is true in much of Africa, nearly the whole of Asia, except in Siberia where Russia has developed the use of power on its collective farms, and in South and Central America except for considerable modernization of corn and small grain growing in Argentina and spotty developments in modern farming of cotton and sugar lands where large owners have introduced power and machines.

The speed with which power and machinery have changed the age-old methods of getting food and clothing from the soil and saved man from the bugbear of excessive man-hours is attested by carefully prepared statistics. Other factors than laboursaving

are, of course, recognized as resulting from the use of power and machinery—better quality of product as the result of having the work, particularly the harvest work, done at the right time; better yields resulting from precise planting and proper placing of fertilizers and more thorough harvesting; and less waste through weathering and rotting.

The tables prepared by the U.S. department of agriculture are presented as showing the hours of man labour required in growing an acre of wheat (20 bu. to the acre) at various times—by so-called hand methods in the period about 1830, by machines in 1896 and again in 1940. Not all the operations in 1830 were done by hand, of course. Horses (or probably oxen) did the plowing and harrowing and hauled the bundles of grain to the threshing floor.

Table I.—*Approximate Labour Requirements for Major Operations in the Production of One Acre of Wheat* (20 bu.)

*Hand Methods, About 1830*

| Operation | Equipment used | Operators Number | Power | | Man-labour Hours |
|---|---|---|---|---|---|
| | | | Horses Number | Tractors Number | |
| Plowing | Walking plow | 1 | 2 | | 6.7 |
| Sowing | Sack | 1 | | | 1.2 |
| Harrowing and covering seed | Brush | 1 | 2 | | 2.5 |
| Reaping, binding and shocking | Sickles | 2 | | | 20.0 |
| Hauling bundles to barn | Wagon | 2 | 2 | | 4.0 |
| Threshing and stacking straw | Flail and forks | 1 | | | 13.3 |
| Winnowing | Shovel, sheet, and measure | 3 | | | 10.0 |
| Total | | | | | 57.7 |

By 1896, according to the same source, an acre of wheat in the winter-wheat belt, where the growing of the crop was not so highly specialized as in the more strictly wheat area of the Great Plains, required only 8.8 man-hours. Table II shows the details and records an event of great significance to modern agriculture—the arrival of the farm tractors, which at this time did only threshing work.

Table II.—*Approximate Labour Requirements for Major Operations in the Production of One Acre of Wheat* (20 bu.)

*Machine Methods in Central Winter-Wheat Belt, U.S.A., 1896*

| Operation | Equipment used | Operators Number | Power | | Man-labour Hours |
|---|---|---|---|---|---|
| | | | Horses Number | Tractors Number | |
| Plowing | Two-bottom gang plow | 1 | 4 | | 2.0 |
| Sowing | Broadcast seeder | 2 | 2 | .. | .2 |
| Harrowing and covering seed | Seed harrow | 1 | 4 | .. | .3 |
| Harvesting | Binder | 1 | 3 | | .7 |
| Shocking | | 2 | .. | | 1.3 |
| Hauling bundles to thresher | Wagons | 12 | 16 | .. | 2.0 |
| Threshing and stacking straw | Thresher and forks | 7 | .. | 1 | 1.0 |
| Hauling water and fuel | Wagon and barrels | 1 | 2 | .. | .2 |
| Hauling wheat to granary | Wagons | 1 | 4 | | .9 |
| Unloading at granary | Shovels | 1 | | | .2 |
| Total | | | | | 8.8 |

Table III.—*Machine Methods in Great Plains, U.S.A., 1940* (20 bu. per acre)

(Figures for one acre)

| Operation | Equipment used | Man-labour hours |
|---|---|---|
| Plowing | 2-bottom gang (14") | 1.5 |
| Disking | 7-in. tandem disk | 0.4 |
| Harrowing | 12-ft. harrow | .2 |
| Drilling | 10-ft drill | .4 |
| Harvesting and threshing | 5-ft combine | .8 |
| Hauling to granary by truck | | .8 |
| | Tractor power | |
| Total | | 4.1 |

At the time represented in Table III showing the rise of mechanization in wheat production in the United States, the farm tractor had long been an important factor not only in grain farming in that country but in many other parts of the world—Great Britain, western Europe, Russia, South Africa, Australia, Argentina. It had become a factor in corn (maize) production and in growing even those crops that do not require such extensive acreages.

From the time agricultural engineers really began developing power machinery for field work, about 1900, the tractor and the machines drawn or pushed with it have been modified extensively—the tractor to be made more suitable for the machine and the soil, and the machines to adapt them to the tractor and the soil and to specific crops. Tractors have become progressively lighter, better suited to many field machines and to smaller farms and smaller fields—in other words, a handy source of power. In the modern agricultural communities of many countries the generation of farm boys running the farms in the 1940s knew about tractors and the tractor way of doing work from the beginning of their farming. But the tractor is not the entire change—it is the symbol of a long chain of modernization, including a procession of plows, planters, fertilizer distributors, cultivators, harvesters, loaders, storing machines (elevators), and equipment for preliminary processing, such as the cleaning and ginning of cotton and the preparation of flax fibre and other materials that are partly processed before leaving the ownership of the farmer.

Along with the rapid adoption of power for field work (drawbar power), belt work and for hauling on the highways, there was a rapid increase from 1910 on in the use of electric power on farms as well as of electric current for lighting. This growth in rural electrification was most conspicuous in Germany, the Scandinavian countries and the British Isles. However, after 1930 there was a great increase in the number of farms in the United States using electric power, in part the result of government development work. Along with the rise in the number of farms electrified came new applications of electricity such as for chicken and pig brooders and as power for hay drying. In many places there has been a great increase in the use of milking machines and other dairy equipment.

**The United States.**—In the United States, where the number of farm tractors manufactured annually increased from 4,500 in 1910 to 358,550 in 1941, the use of horses and mules decreased accordingly, the total number falling from 24,000,000 to about 12,000,000. There were about 2,000,000 tractors in the United States in 1944. A conspicuous change was in the adaptation of all kinds of field equipment for various crops to the use of mechanical power. Furthermore, there was a noticeable spread in the use of power to include more operations and crops that require special equipment. Examples of the latter are machines for planting so-called sheared sugar-beet seed (cut down so as to get rid of multiple-germ seed balls and reduce the plant thinning job) and corn picker-huskers (adapted to fields of 50 acres or more). The use of power and machinery on farms in the United States was at one time thought to mark the beginning of the end of the family-sized farm, but the size of a family-sized farm is larger than it once was (size depending on the kind of farming), and engineers and manufacturers have built machines for use on smaller and smaller farms. The small so-called handy tractors are a good example of this trend. Many improved machines are of as much benefit to family-sized and small farms as to large farms. This may be said of many planting machines and fertilizer distributors. It can also be said of much labour-saving equipment for use about the farmstead—for example, milking machines, coolers, and shop equipment such as grinders, saws and drills.

The rise in the use of power and machinery on U.S. farms is in no way better emphasized than by the fact that in practically every one of the 48 states there is a state-paid agricultural engineer as a part of the educational organization known as the extension service, whose duty is to acquaint the county agricultural agents, and through them the farmers, with the most useful new mechanical equipment and practices.

For the United States the advances in this field might well be summarized as: (1) a rapid increase in the use of power, largely internal-combustion engines and electric motors; (2) application of power to more farm operations; (3) a greater variety

of better machines; (4) machines for small farms as well as large; (5) great expansion in rural electrification; (6) improved machinery and methods for harvesting hay to cut cost of labour and improve quality; (7) great increase in self-propelled farm machines such as combine harvester threshers, and tractor pulled and operated picker-huskers and balers; (8) better planting and fertilizer distributing equipment and practices; (9) electrical equipment for farm refrigeration and quick freezing; (10) new practices in weed control, including use of machines and even burning contrivances (experimental); (11) ways of reducing draught of farm machines; (12) safety devices; (13) more durable material in machinery.

**Great Britain.**—In Great Britain, where the system of cable plowing by means of stationary steam engines which pull plows back and forth with cables wound on drums had been extensively used, the gasoline tractor increased greatly in numbers, particularly following the outbreak of World War II. The scarcity of labour for farms made greater use of power a necessity and many more tractors were built and great numbers imported from the United States. As in the United States, the tendency in the 1930s and 1940s was toward the moderate-sized or handy tractor, the one-plow or two-plow kind being much in favour. From 1939 to 1944 the number of tractors in Great Britain increased from 55,000 to 160,000.

The British, as was to be expected, applied power and new machines to the problem of getting the best returns from grass. Because of frequent rains, putting up good quality hay is difficult and the storing of grass in silos became popular with the more progressive farmers. Machines which cut the grass into short lengths and elevate it into wagons or trucks are a satisfactory means of harvesting this large-acreage crop.

British farmers, especially after the outbreak of World War II, made increased use of the grain combine—the harvester-thresher—and the use of this machine, as grain was often damp because of lack of curing, led to an increase in the use of grain driers.

Some grain harvesting in the British Isles is done by a system in which the grain is cut with a reaper and not bound in bundles, the unbound grain being elevated to a wagon and hauled to the thresher. British threshing machines not only separate the grain from the straw, but chaff, short straw, long straw and dirt are all delivered in separate piles which makes it possible to utilize the various materials to the farmer's liking. The method fits in well where the coarse materials are needed both as feed and as bedding for livestock.

Because of the high humidity, pastures in some parts of the British Isles often become choked with a growth of moss, and this has led to the use of the moss harrow in spring and early summer.

The Institute for Research in Agricultural Engineering at Oxford university, England, conducts investigations on all sorts of farm engineering problems and has a tractor-testing plant similar to the one at Lincoln, Neb., in the United States. The institute's tests have had a considerable effect on increasing the use of pneumatic tires on farm machines. Other work has had an effect in reducing the draught of plows and other implements.

By and large, the increased use of power and machinery in Great Britain in the second quarter of the 20th century has not changed the farming systems, but has made for more economical application of them and for more convenience of the farmer. Output went up gradually as the number of workers on the land went down.

**Russia.**—Russia (the U.S.S.R) was able to take over tractors and the other machines of mechanized agriculture rapidly because it overcame the disadvantages of small farms through the establishment of collective farms and systematic planning of measures and machines to be adopted over a definite period—for example, planning for a five-year period. In many important crop-producing regions of that country the topography, soils, presence of cheap fuel and the nature of the main crop were such as to invite the rapid development of tractor farming. Men were trained to the new farm form in one generation. By 1940 a large part of the farming of the U.S.S.R. was done on collective farms or *sovkhos* and machinery is the heart of these farms. These collectives consist of small peasant farms amalgamated for more efficient and economical operation. The medium-sized and small collectives get their machines as they need them from the state tractor stations. Large state farms have their own machines.

A decade before the outbreak of World War II large tractor and harvester-thresher plants in Russia had attained a considerable output. Among these was a large tractor plant at Stalingrad and the combine-harvester plant at Saratov in the lower Volga region. Although farm implements were made in Russia before 1914, no tractors or combines had been made there. These machines imported at first and then made at home were the outstanding development in the mechanization of Russian agriculture. They have to do mostly, of course, with the production of wheat and other small grains, but tractors, especially, are the foundation of economical seedbed preparation and harvesting of various other crops to a greater or lesser extent, depending upon the accessory machines available for the particular crop. Modern machinery has been adapted extensively for cotton production, including trials of mechanical pickers and the establishment of gins with [illegible] equipment and hydraulic presses. The growing of [illegible] has also been modernized through the use of special machinery as well as tractors and modern plows. There was a strong tendency after 1926 to try out all new developments in farm machinery and to develop new ones through experiment.

**Germany.**—Germany's variety of agricultural machinery at the beginning of World War II is shown by the machines listed as of considerable number in that country's census of May 1939. The list includes more than 1,800,000 electric motors, two-thirds of them 1 to 6 h.p., 11,755 steam engines, more than 200,000 gasoline and oil engines, nearly 70,000 tractors. There were large numbers of motor mowers, choppers, seeders, fertilizer distributors, cultivators, winnowers, harvesting machines, potato pickers, threshers, forage cutters and wagons with rubber tires.

The Germans found a strong appeal in tractors (mostly small ones) powered commonly by diesel or semi-diesel engines, not particularly because of the saving in labour, but because of the need to conserve as much of the crop land as possible for growing the kinds of crops needed for human food. Every horse replaced by mechanical power meant 3 to 5 acres of land available for growing crops. Tractors and trucks were much used for transportation from the farm to market.

As in some other European countries and in Great Britain, farm machinery in Germany was designed to bring the farmer that little additional yield that is so much appreciated where land is none too plentiful. The row cultivation of wheat in Germany is an example, also the extreme care given to accuracy in drills for planting grain.

In Germany before World War II almost 100% of its farms were reported to have electric power. One reason for this wide distribution is the fact that these farmers live in villages and can hook up to electric lines easily and at low expense. On the other hand, they are not said to be heavy users of current.

In Germany considerable study was given to conserving and spreading barnyard manure, the solid and liquid parts often being handled separately, a tank for the latter.

**France.**—France has long been a country of farms made up of small scattered patches so that power machinery has not made the headway it has in Great Britain, Germany and Russia. The French, however, have been noted for good draught horses and have loved and tended their soil, saving manure carefully and hauling it in carts and tanks for distribution on the land. Small tractors made some headway, but it is not to be compared with the progress in the countries mentioned above. However, much attention was given to spraying and dusting machinery, largely for protection of fruit and vegetable crops, and, to some extent, to machines for placement of commercial fertilizer.

As might be expected, the limitations on the application of heavy machinery and the use of tractor power tended to keep down any large development of farm machinery manufacturing in France. Agricultural engineers studying French farming in the period just before World War II reported the farmers much in-

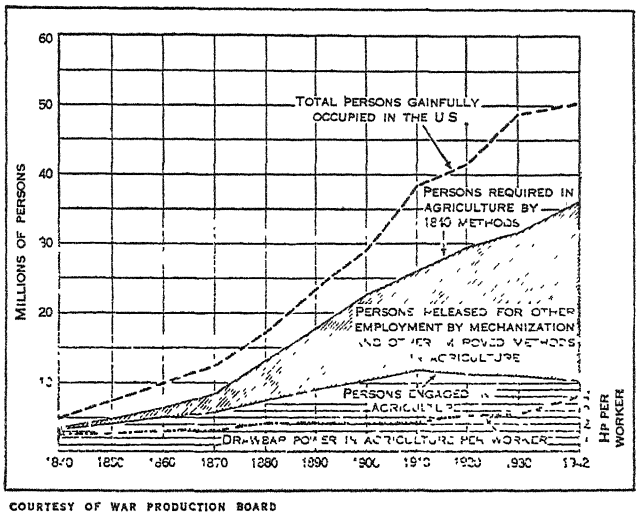
terested in mary new machines developed in the United States, particularly in the lighter equipment, but very little new machinery was bought. In that period France showed a growing use of electric power by farmers, but not to the extent noted in many other European countries and in England.

Before World War II France's ministry of agriculture maintained the Central Agricultural Machinery Testing station at Paris, principally for the study of physical-mechanical characteristics of the soil and to demonstrate the quality of tractors and other machines.

**South Africa, Australia, New Zealand and Argentina.**—In South Africa, Australia, New Zealand and Argentina there have been trends toward wider use of farm machinery. Wherever petroleum fuels are expensive and upkeep of horses relatively low, as in Argentina, there is a strong tendency for farmers to keep to animal power. In all these countries what mechanical power there was on farms was used mostly for seedbed preparation and grain harvesting. In New Zealand the importance of the dairy industry stimulated the use of dairy machinery and equipment.

**Africa.**—In Africa (except South Africa), from the valley of the Nile through practically the entire continent, the raising of crops is a series of primitive operations with very simple tools and poorly developed work animals. For the most of Asia, the same can be said for all the crops—cotton, rice, etc. In some areas in the far east where U.S. or European influences have been at work there has been some tendency toward mechanization and organization for more efficient production, as in the production of sugar cane, abaca (Manila hemp) and rubber. But, by and large, hand labour is the dominant factor since it is cheap and has long been accustomed to the crops.

**Machine Influence on Quality of Work and on Product.**—With machines and power available farmers soon found that not only could they do more work, and usually do it more economically, but that they could do a better quality of work. For example, plowing could be done deeper and even in the more difficult soils with a smooth steel mouldboard of proper design




COURTESY OF WAR PRODUCTION BOARD

FIG. 1.—EFFECT OF MECHANIZATION AND OTHER IMPROVED METHODS ON THE NUMBER OF PERSONS REQUIRED IN AGRICULTURE, 1840-1942

and a good margin of power. The importance of this power advantage is shown when it is necessary to plow under a heavy growth of rye or some legume crop for soil improvement. Farmers with relatively lightweight work animals find it difficult or even impossible to do such work in a way to leave the growth sufficiently covered with soil. On the other hand, with adequate mechanical or animal power, it is possible to do much better work and, what is more, the job may be finished in a favourable time. When it is possible to harrow the soil immediately after it has been turned by the plow by means of a harrow drawn behind, the use of that extra power produces a better seedbed more quickly and more easily. By using accurate planters and cultivators designed to fit the standard spaces properly, this work can be done with the minimum damage to the growing crop and the maximum of weed control, considering the time that can be spent on it. Modern harvesting machines have been adapted to all sorts of crops, and can be adjusted so as to do the minimum of damage to grain, potatoes and other products. Even the relatively simple factor of the cleaning of grain such as wheat—keeping out pieces of stalks, leaves, weed seeds and broken pieces of grain—is important in insuring a lower moisture content and in reducing insect infestation.

Planting machines insure more accurate placing as to depth in the soil, and as to space between rows and between seeds, all of these factors important in the development of plants and in proper cultivation and harvesting. In the period after 1930 great attention was given to the accurate placement of fertilizers for row crops, particularly in the United States. This was found a means of doing much better fertilization work, producing better yields, often at a saving in plant food, commonly producing a better quality crop. Modern spraying and dusting equipment not only saves fruits and vegetables and sometimes other crops from the ravages of insects and fungi, but similar methods and equipment are used for other purposes which also improve yield and quality. In the 1940s there was developed in the United States a method of spraying maturing apples and pears on the trees with certain highly diluted hormones which prevent preharvest dropping of the fruit. This reduces the percentage of damaged fruit and effects an economy in picking, as in treated orchards it is unnecessary to shift workers from one part of an orchard to another to pick from trees that have begun to lose fruit. In this same period devices for applying chemicals in vapour form in the soil to kill destructive nematodes were developed.

It may be well to mention also the development of a so-called aerosol "bomb" for use in combating insects by diffusing various insecticides widely and easily through use of a highly volatile chemical confined in a steel cartridge. These "bombs," equipped with handy valve releases, were widely used by the fighting forces on various fronts in World War II as a means of destroying flies, mosquitoes and other insects dangerous to health. The method is widely used to insure the eradication of insects in aeroplanes that might carry the pests into countries that had been free of them. By 1944 experimental work on this method in the United States was directed to the possibilities of effective use in garden and field.

Most machines that tend to make crops grow better and with less interference from various factors contribute an improvement in quality. Other machines—beyond the harvesting machines—permit a better utilization of various products. For instance, feed grinders, silage cutters and shredders increase the feeding value of roughages and other feeds. The manure spreader (and the even more modern manure loader) makes possible the better utilization of barnyard manure.

Such processing machinery as cotton gins and accessory equipment including driers and cleaners are necessary to retain whatever good qualities the fibre had when picked. Flax and hemp processing machines are of similar importance to growers of these crops.

Machines of great variety have been developed to make farm products attractive to animals, as feed, or to people who buy them on the markets. Hay is put up in such a way with driers and grinders as to keep the maximum of palatability. Citrus fruits are gassed in chambers to bring out a uniform characteristic orange or yellow colour that may have been masked by green because of conditions in the orchard. Nuts are sometimes coloured and polished to give them a uniform, pleasing appearance.

Machines have had an interesting and indirect effect on crops that is also of high economic importance. The strong demand from farmers for more and more machines and ever more efficient ones led the plant breeders and engineers to a kind of collaboration that is yielding good results in plants and machines better fitted to each other. A few examples will suffice: hybrid corn (maize) has been so bred that the height of the stalks is uniform and the ears are at uniform height, facilitating harvest with the

mechanical picker-husker. Another characteristic accentuated by the plant breeders is the tendency of the plant not to go down easily in the wind thus making it hard to harvest.

The strong stalks bred into many varieties of wheat and other small grains have become popular in many parts of the world because they do not "lodge" or crinkle down readily and thus cause heavy losses of grain the harvester fails to catch.

In the southwestern United States in the somewhat arid plains country plant breeders have adapted grain sorghums to mechanical harvesting machines by creating much shorter or dwarf varieties with upstanding seed heads to take the place of those that curved over.

Such changes make for economy in harvesting and better quality in most instances.

The effect of the machine on quality often goes far beyond the immediate effect. For example, a corn (maize) harvester, that is a picker-husker, may be kept in good adjustment or may get out of adjustment and put much trash such as husks, silks and loose kernels in the wagon with the ears. This accumulation interferes with ventilation in the crib and may cause a heavy spoilage loss, especially in seasons when the grain has not matured well.

The use of machines for the betterment of the quality of work has gone so far in some areas as to tax the credulity of persons in other areas where mechanization has received small attention For example, in California a great part of the commercial rice crop is sown from aeroplanes Formerly the fields were planted with ground machines and later flooded as a means of watering and controlling weeds, and the fields drained before harvest. A later technique is to flood the fields early to prevent weed growth, then sow the seed from the aeroplane into the water and then, as before, drain the field for harvesting

The new method saves labour and practically eliminates the weed competition. Not only is the work better, but the crop harvested is better. Planes are often used for dusting cotton and trees with insecticides.

**Economics of Farm Machinery.**—At no stage in the development of farm machinery and mechanical methods has it been possible for all farmers to use the machines of their time economically. It is even less so (1944) as may be seen readily when reflection is given to such practices as the use of planes for planting or for fighting pests. However, more and more kinds and sizes of farm machines are made available to small farmers and in some places the use of machines or of machines and operators has been made available at a price. In parts of the United States cotton belt men do custom aeroplane dusting of cotton for planters of an area.

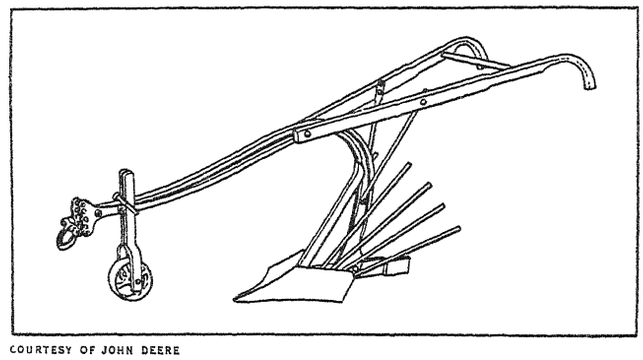
Horse-drawn planting machines, such as corn planters and bean planters, that were just pushing the hand planters out of use in commercial farming at the end of the 1890s are found everywhere in the western world and many of them have become multiple-row planters drawn by tractors. Farmers in the more progressive farming regions commonly have steel plows. These have spread over the world after about 1840. Because it slipped through the soil more easily—that is, "scoured" well—the draught of the steel plow was less and made farming easier for man and beast. For the farmer it was easier physically and economically. Mechanical improvements in farming have been frequent reductions in draught. Plow improvements of this nature continue. In the second quarter of the 20th century there were improvements in the plow that tended to reduce draught, changes in the curve of the steel plow was less and made farming easier for man and plow design to reduce clogging with trash; new coulters and jointers that could pass obstructions with less difficulty. Then rolling resistance on scores of farm implements, including the tractor itself, was reduced through the application to them of pneumatic tires, better lubrication and construction materials also have done their parts in reducing friction and, therefore, draught.

Practically everywhere, except possibly in primitive areas, there is evidence that the economy of the machine has pulled it out in front. In some instances it may be far from the latest development, but the farmer is feeling his way, balancing steel and brawn. The size of the individual farm and the type of farming are important determining factors. A man who raises a small acreage of berries will not use much machinery, but he might have a small tractor and in some localities he would most certainly have a truck for marketing and for hauling supplies. A dairy farmer with a dozen or more cows would frequently be found to have a milking machine, maybe with more than one unit, possibly a cream separator, almost certainly, in some countries, a manure spreader, haying machinery, and if he is right out in front in a rainy country (in 1945) he would have a hay drier in his barn.

It has become generally recognized in Europe and the United States that electrically operated tools are an economy for electric current has become widely available at reasonable rates. Sharp tools save time and improve the quality of work With an electric grinder a farmer keeps his tools in better condition with a smaller expenditure of time.

As they have become better acquainted with machines, farmers of various countries have been less prone to overinvest in such equipment. Machines must not lie idle too much. Therefore, they must be adaptable enough for various jobs or be used jointly in the community unless farms are large So, before buying a machine a farmer must assure himself that he has at least the minimum amount of work that would justify the investment.

The potato crop may be used to illustrate how a farmer might proceed under different conditions: the cheapest way to dig a small patch of potatoes is with a fork; if the area in the crop is an acre or so the farmer would likely make a good return on money invested in a simple potato plow, while a larger area



COURTESY OF JOHN DEERE

FIG. 2.—HORSE-DRAWN WALKING POTATO DIGGER

This model is particularly suitable for harvesting sweet potatoes. The rod mouldboards free potatoes from dirt and drop them on the ground. Gauge wheel regulates depth

would justify purchase of a more complex machine But the use of machinery involves consideration of factors other than relative cost of the operation in comparison with the cost by other methods. The speed with which the work can be done, especially when the state of the weather and the possibility of its continuance or change are considerations, is of primary importance even though the value is hard to measure. The study of farm cost accounting has been of help in a better understanding of these problems.

As machines have been designed to serve farmers better, their use has increased, and the size of farms and the improved land in them has become greater. In the United States, where the use of farm machinery has shown perhaps the greatest increase, the average acreage of improved land per agricultural worker went from 23 1 in 1880 to 38.4 in 1940; and the value of agricultural implements and machinery per agricultural worker went from $45.74 in 1870 to $365.81 in 1940.

Using the estimates of the department of labour (U.S.) for nine important crops (barley, corn, cotton, hay, oats, potatoes, rice, rye, wheat) and comparing the machine methods of about 1895 with the hand methods of earlier times H. W. Quaintance (*The Influence of Farm Machinery on Production and Labour*) states: "Taking the percent of labour saved as indicating the average proportion of these crops due to the use of machinery, it appears that the quantity of products is almost five times as great, per unit of labour, as it formerly was." This suggests how ma-

chinery has enabled agriculture to supply labour to the industrial cities and for commercial activities and still increase the output, as was suggested in the introduction to this article After an extensive study and presentation of data on 15 crops (barley, broom corn, corn, cotton, hay, oats, onions, peas, potatoes, rice, rye, sugar cane, sweet potatoes, tobacco, wheat) grown in the United States, the same author says: "Surely it will not be too much to say that during the last half of the 19th century the cost of production[1] of these crops was reduced by one half." There is ample evidence that the influence of machinery in effecting economies in production costs has gone on at least unabated after 1895. In 1940 figures available in the U S. department of agriculture indicated man-hour requirements per acre as follows, under highly mechanized conditions except in cotton: corn 5 1, wheat 4 1; hay 3 5; cotton 73 0. Cotton felt mechanization less than the other major crops.

**Other Effects of Machinery.**—Beyond doubt the wide adoption of farm machinery has had much more than economic effects Farmers, and particularly young people on farms, give great consideration to the convenience of machinery, to the fact that it does away with much drudgery and dignifies the work perhaps as much as scientific knowledge of the problems of the farm, and as much as skill in the performance of hand work. More often than not the use of machines leads to a better quality of work. A simple illustration will serve to explain one factor in this better quality. A man sharpening the knife of a mowing machine with a power grinder is much more likely to make all the sections sharp than if he were doing the work with a grindstone operated by himself with a treadle. Farmers can plant crops much better with an automatic planter both from the standpoint of the requirements of the crop itself and from the standpoint of the farmers' problems in caring for it and harvesting it. Modern machines and methods used on almost any of the important crops—wheat, maize, sugar beets, potatoes—could be used to illustrate the point. Here economics and the more elusive factors are on common ground.

The introduction of improved farm machinery frequently met with resistance from those who expected bad effects on employment, and at times active resistance developed. When early wheat harvesters (binders) were introduced in the developing wheat belt of the United States many of the machines were burned or damaged in other ways by worried farm hands. These machines, and the still more effective ones that have succeeded them and each other, resulted in wheat production greater than ever known before and were one of the important factors in creating a higher standard of living and in making food production more readily adjustable to meet emergencies.

At times men supposed that the introduction of farm machinery led to falling rural population, but there is evidence that in many instances the invention and introduction of labour-saving machinery for the farm followed the draining of labour away from the land. As an example, self-binding grain harvesters were invented and developed by more than one man at about the same time when the rapid increase in industrial activity lured an ever rising stream of labour from the fields. It was not railroads alone that were responsible for the rapid settlement of great agricultural areas in the United States, Canada and Australia during the 19th century; improved farm machines and implements had much to do with it. Without the machinery much of the land cropped in these areas would have been used for grazing or for timber.

The more machines are used for farming, the more skilled the workers become and the higher the wages that can be paid them. A demand for skill and a desire to acquire it tend to improve the quality of the rural population.

Although automatic equipment and higher quality tools are made in sizes and at costs that make them suited to many small and medium sized farms as well as large ones, there has been a decided tendency for the use of farm machinery, and more convenient power to increase the size of farms. In the northern part of the Mississippi valley where more machinery is used than in any other region of general farming the improved land per farm has steadily increased after 1850. In regions where general farming is practised but where machinery has not been used so much, the cultivated acreage has not increased so rapidly, and in some areas farms have even become smaller. In some instances, of course, such a tendency might be explained on the basis of a change in type of farming, such as from general or livestock to truck, because of a new market, for example, in a rising industrial area.

If the total investment in all farm property in the United States is considered, the increase after 1850 has been much greater in the farming areas in which machinery is widely used Land is the largest item in farm valuation, but its value depends to an extent upon the means at hand for making it productive. Many factors enter into increases in value, but the reduced costs made possible through machinery should always be kept in mind.

There is scarcely a farm operation in the more progressive regions that does not require less drudgery than it required, say, in 1880, or in 1900, or even in 1910, and in some instances, 1920 One farm operation that had drudgery or "stoop labour" taken away from it after 1920 was the thinning of sugar beets. To mention a few other operations that have gradually lost much of the strain and monotony over the years, where machinery has been used, there are milking, corn cutting, haying, plowing harrowing all the operations done with tractors and many of those done with engines and electric motors. Most farmers are, perhaps, as busy as their grandfathers, but they work more with their heads and their skills than with biceps and backs, and they work to the better advantage of themselves and society. In 1800 most nations had to have a large proportion of the people working on farms to provide themselves and the small industrial and business groups with food, clothing and a few other materials. In the second quarter of the 20th century an active industrial-agricultural country such as the United States had less than one-fourth of its population engaged in farming and nevertheless had farm products for export. It did, however, buy some farm products from other parts of the world—rubber, waxes, coarse fibres, etc

There is primitive farming even in modern times, some of it here and there in the most progressive agricultural countries, but modern farming is a relatively complex business even though frequently highly specialized. The first-class farmer, with many machines and exacting requirements as to breeds, varieties and mechanical and biological processes, has exchanged drudgery for application and intensity of mental effort and still has much physical labour in his lot. But he and his wife and children have a higher standard of living—more conveniences, better schooling, greater opportunities for reading and for carrying on other cultural activities. In other words, they produce more and get more, at least in many ways.

**Classification.**—Types, kinds and sizes of agricultural machinery and implements form a complex subject. Agricultural conditions into which machinery must fit vary widely between the one-horse farms found in many countries (even the most progressive), and the great wheat ranches of Canada and the United States; the operation of a hill farm varies from that of a rich valley corn farm, and the latter, in turn, is vastly different from a citrus fruit ranch. Differences in size of farms, in size of fields, in kinds of crops grown, and in the kind and size of power units most economical or practical—all cause variation in type and size of machine or implement. For a small field, one can buy a one-horse or one-mule implement for a very few dollars, or for a great plantation one may buy a special harvester which costs several thousand dollars. Because of the wide variation in soil types some large manufacturers find it necessary to make more than 100 different shapes and kinds of mouldboards for plows in addition to the disk type of plow which is demanded in very hard, in very fluffy or in very sticky soils. Land values have some influence. Then, last but not least, the human equation enters; differences in peoples and in regional customs add complication. The farm labourer of low mental calibre and of little mechanical skill requires a smaller, simpler implement than the skilled oper-

[1] Cost of production here is based on cost of labour and does not include differences in [illegible] hand and machine methods. This discrepancy, if it seems [illegible] y the fact that labour by hand methods [illegible] at the rate [illegible] machine methods it is con[illegible] the [illegible] of the higher wages current about 1895.

ator who commands a tractor hauling a combination of implements which performs two or three operations in one trip over the ground.

Space does not permit description of all kinds of agricultural machines and implements Fortunately, however, the subject lends itself to classification according to the purpose of the machine. Most of the agricultural machines, implements and tools used by farmers may be classified according to purpose. The list includes only those items considered part of the business of raising or making agricultural products, up to the moment those products are sold out of the farmer's ownership. It does not include the strictly household conveniences, devices and utilities which are becoming so widely adapted to assist the housewife and to enable the farmer and his family to enjoy more the art of living.

*Machines and Implements for the Reclamation, Maintenance or Improvement of Land:* stump pullers, pilers; brush breakers, cutters, power brush and tree saws; burners; open ditch, tile ditch and mole ditch machines; land drain cleaners; land levellers; terracing scrapers, bulldozers, graders, moss harrows; irrigation pumps, land planes (for levelling fields for irrigation), sprinklers water controls, ditchers; sub-soilers; limestone crushers; lime and fertilizer distributors (artificial manure distributors); manure loaders, lifters, muck grab spreaders; straw spreaders; stone pickers

*Machines and Implements for Seedbed Preparation:* mouldboard, disk and polydisk plows; lea, sod, stubble breaking plows, drags; spike-tooth, spring-tooth, chain, zigzag disk and special harrows; smoothers and pulverizers; plain, corrugated and bar rollers; surface and subsurface packers; clod crushers; rotary, gyro and special tillers; sweeps; listers; ridge busters; stalk cutters, shavers; cotton stalk choppers; stubble diggers, pulverizers; markers.

*Machines and Implements for Seed Preparation:* fanning mills; grain, pea, bean, cottonseed, peanut, flax, onion set, rice, potato and corn cleaners, graders and sorters; seed scarifiers; sugar-beet seed slicers; seed dusters (for fungicides); seed testers; seed stringers; seed driers; tippers (for use in shelling seed corn); potato cutters.

*Machines and Implements for Seeding and Planting:* broadcasters, broadcast sowing machinery; grain, beet, grass and garden seed, bean, pea, corn (small grain), onion and rice drills; corn, cotton, beet, potato, pea, bean, onion and peanut planters; transplanters; seeders, wheelbarrow seeders; markers; lister-planters; fertilizing attachments.

*Machines and Implements for Cultivating:* corn, beet, cotton, potato, sugar-cane, vineyard, orchard and garden cultivators; celery, potato and tobacco hillers; drags; spike-tooth, spring-tooth and disk harrows; weeders; rotary hoes; crust breakers; ridgers; renovators; sweeps; root blockers; cotton scrapers, choppers; thinners.

*Machines and Implements for Harvesting:* mowers; tedders; "flop-over," dump and side-delivery rakes; "bull" and sweep rakes; hay, shock, bundle and cane loaders; crop collectors; stacking elevators, stackers; bunchers; windrowers, straw and hay balers, pickup balers, roller balers; reapers; grain and corn binders; grain and corn headers; header-binders; combination harvester-threshers; corn, cotton, potato, peanut and fruit pickers; corn picker-huskers; flax pullers, cleaners, tow shakers; grass cutter-chopper-loaders (for ensilage); root and plant lifters; potato and peanut diggers; root toppers; bean, pea, beet, celery, grass seed, spinach and onion harvesters; field ensilage harvesters; seed and cotton strippers; sugar-cane cutters, harvesters; corn and hemp cutters; shock compressors, movers, sweeps; huskers; milking machines; wool clippers; tree fellers.

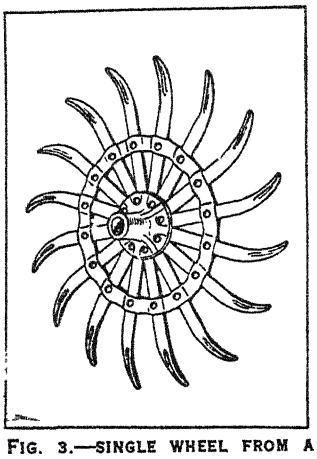
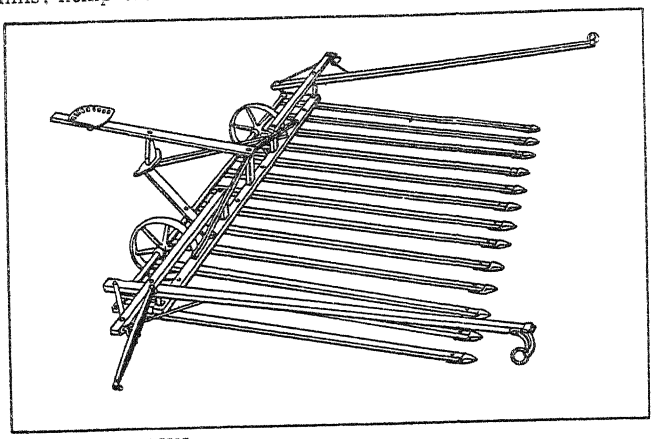


FIG. 3.—SINGLE WHEEL FROM A TRACTOR-DRAWN ROTARY HOE

The rotary hoe is used for early cultivation of all kinds of row crops, pulverizing the top soil and tearing out weeds. Each section of the hoe cultivates one row and is composed of fourteen 20½ in. wheels

*Machines for Preparing Products for Market:* grain, pea, bean, peanut and rice threshers and cleaners; alfalfa, clover, almond bean, pea, grain and rice hullers; grain, pea, bean, cottonseed peanut, onion set, rice, potato, corn, berry and fruit cleaners, graders and sorters; cotton gins and presses; balers; produce washers; produce waxers; grain polishers; corn, peanut, rice and popcorn shellers; vegetable bunchers; cream separators; milk emulsifiers, pasteurizers, sterilizers, irradiators; milk coolers, aerators; churns; butter workers; bottling machines; cheese and lard presses; sugar, fruit, sorghum and syrup evaporators; honey extractors; berry and fruit crushers; cider and juice mills, presses, extractors; bleachers; pitters; parers; sugar-cane and sorghum mills; hemp breakers and cleaners; saw mills; baggers; weighers



COURTESY OF JOHN DEERE

FIG. 4.—HORSE-DRAWN TRUSS-FRAME RAKE

*Machines for Feed Preparation and Feeding:* cutting boxes, ensilage and fodder cutters; feed mills (including hammer mills), grinders, cake breakers, mealers; roughage mealers; feed mixers, shredders; root and vegetable cutters, pulpers; feed cookers, stock feeders; bone cutters; corn and cob crushers; silo packers

*Machines and Implements for Combatting Crop Enemies:* row crop sprayers, tower sprayers, aerosol "bomb" (experimental in 1944) sprayers using liquified gases in steel cartridges as a means of propelling the insecticide or fumicide in extremely fine particles; field burners; flamers; stubble pulverizers; stalk crushers (for killing larvae that might otherwise survive in waste material); insect sweeps, poison bait spreaders, catchers, traps; tobacco bed burners; seed treaters; smut cleaners; fumigators; soil fumigators for nematode control.

*Machines, Implements and Conveyances for Transportation:* automobiles; motor trucks; wagons; carriages; horse and hand carts; sleighs; bobs; stone boats; wheelbarrows; farm, wagon, log, lumber, header and sugar-cane gears; racks and barge boxes; hay carriers, forks, slings; blowers; grain dumps, elevators; car loaders; feed and litter carriers.

*Power, Light and Heat Generators:* gas, gasoline, paraffin, distillate, kerosene, hot air and steam engines; steam and internal combustion tractors; boilers; windmills; turbines; water wheels; hydraulic rams; tread mills; power sweeps; electric motors, dynamos, generators; lighting plants; containers for compressed illuminating gas (bottled gas); tank heaters.

*Miscellaneous Machines, Implements and Tools:* incubators and brooders; disk and knife grinders; pumps and pump jacks; hay knives and hooks; hand hoes, mattocks, rakes, shovels, forks; corn, cane, tobacco and cabbage knives; pruning and grafting hooks, knives, shears and saws; fence stretchers; hog rubs; post-hole diggers, augers; lifting jacks; animal pokes and leads; dehorners; poultry debeakers to prevent birds injuring each other; horse and cattle clippers; grooming machines; milk and cream testers; utensil washers, sterilizers; scales; ladders; hand tools

and machines for wood and iron work. (*See* TILLAGE MACHINERY; DAIRY MACHINERY AND EQUIPMENT; HARVESTING MACHINERY; PROCESSING MACHINERY. Also such articles as SHEEP SHEARING MACHINES; TRACTORS; DRAINAGE OF LAND; etc.)

## HISTORY

From pictorial and other ancient scraps of evidence it seems certain that in very early times man used devices for making the soil more productive and the struggle for food and clothing easier. It is reasonably safe to say that once started on this road of improvement through invention and planning, the chain of change was never broken up to 1945, with agriculture feeding, clothing and providing materials for various purposes for more than 2,000,000,000 persons.

Studies of ancient civilizations in many parts of the world, including some regions of Central and South America, indicate cultivation of the land was going on hundreds of years B.C., even 1,000 years or more B.C. in Egypt and China. Such dates could be put much farther back on the basis of what it is certain men must have observed when they began gathering grains, fruits and roots to provide some degree of food security beyond the day or the season.

The first soil working implements very probably were the crude pieces of wood that provided the idea for shaping such chance pieces into the first hoes; the first rake very likely was a leafless branch of a tree with stiff twigs. When man had a hoe he really had his first plow; and when he had a wisp of brush for a rake he had his first harrow. Brush harrows are still used, and not too badly either, when the branches are fitted into a rigid frame or holder. Harvesting at first was simple pulling and picking—and it is really surprising how much of many crops is still pulled and picked and forked by hand in countries where complicated farm machines are common. Since the earliest cultivated crops are supposed to have been cereals and pulse (that is beans and peas and things of that sort), a very early improvement was the sickle. Some sickles in ancient Egypt were made of flint blades in a wooden handle. Later, but still near 1,000 years B.C., the men of the Nile valley used bronze to make the counterpart of the hand sickle. In those days Egyptian grain was trodden out on the threshing floor by animals just as it is even today in near-by Ethiopia and in primitive places in other parts of the world. Wheat and other grains and seeds were winnowed by casting into the wind.

Engineers who have studied the development of agricultural machinery and power generally consider that the first great mechanical advance in farming was the evolution of the plow from the hoe. It became not only an implement for preparing the seedbed and controlling weeds, but a means of covering seed, cultivating the plants, providing drains, building terraces to control erosion and even grew into a harvesting machine for digging such crops as potatoes and sugar beets. Plows were used in ancient Egypt. They marked a great advance in the use of beasts of burden and must soon have stimulated man to begin the long and slow job of breeding up the draught ox and the draught horse, the really great power sources on the land until the advent of the tractor which even in the middle of the 20th century does only a small proportion of the world's field work except in some of the western nations.

By Roman times a primitive ridging plow had been evolved by use of a device similar to the modern double mouldboard. Pliny, the elder, in the first century wrote of a wheel plow, but such plows were not common until much later. He had heard of the use in Gaul of a harvesting machine pushed ahead of oxen for heading or stripping grain. Such machines and a combined plow and drill, invented still earlier in Mesopotamia gave way before the barbarian invasions of these more civilized regions, and mechanical progress in agriculture during the middle ages and until after the Renaissance. But apparently there were small changes from time to time even in that period. In 1523 in England Sir Anthony Fitzherbert's *Book of Husbandry* mentioned plows of different types in different districts and indicated the need for different designs for the various soils in order to cut down draught. By then hand tools had been nicely designed and many of them were much like those of modern times except as to material. By 1600 more elaborate farm implements were appearing in Europe and English books of the day discussed new ways of planting grain. In 1730 Jethro Tull, of England, renowned for his developments in horse-hoeing husbandry, made a seed drill which was really workable and marked the beginning of a new day in the planting of small grains and many other seeds.

In Tull's century plowing matches began in Britain and competitions in the use of drills and horse-hoes. These activities were typical of the lively thought on ways and means of improving farming and easing the load on human shoulders. The tempo of tool improvement has continued to rise ever since. Tull opened the floodgates of farm machinery invention. It was significant that this opening was at the time when the American colonies were beginning to realize what might be done in the new land with better machines and stronger work animals. They began improving oxen and horses as the British and Europeans already were doing, and Americans began working on the plow. Eli Whitney before the end of the 18th century had devised the nucleus of the modern cotton gin. The whole western world was in this same state of mind about agriculture. India had long had a hand cotton gin, the chirka, but the east had not been in the same state of mind about farming. This state of mind, which encompassed far more than agriculture, led to the steam engine, the internal-combustion engine, traction engines, tractors, electricity, milking machines, self-binders, combine harvester-threshers, manure spreaders, grass harvesters, aeroplanes (used for dusting crops with insecticides and even for planting), and whole sets of mechanically operated machines.

**The Steam Engine.**—Even by the opening of the 19th century developments had gone far enough to justify the term "agricultural machinery." Strangely enough to present-day farmers, there was a threshing machine before there was a steam engine. The first workable threshing machine came late in the 18th century and was driven by water or wind power, sometimes by horse labour and later by steam. But steam was not much used in agriculture until after 1830. Then in England a system was devised whereby one or two engines were used to draw multifurrow plows, by means of cables, backwards and forwards across the field. The system of double-engined steam plowing was well established by 1850. Then other heavy implements were added such as the cultivator and mole plow. Then steam threshing was popular and steam engines were used to some extent to run other barn machinery. But for the most part the development of machinery on the farm owes little directly to steam. However, in the early part of the 20th century lightweight steam tractors were used in England for the direct pulling of plows and to some extent also in other countries.

The mowing machine and the self-binder, the tedder and swath turner, the drill, the potato digger, chaffcutters and root cutters all were developed in the first instance for horse or manual labour, though doubtless receiving a fresh stimulus from the general mechanization of industry applied to the farm and the still greater stimulus arising from a shortage of farm labour.

**The Internal-combustion Engine.**—An important practical contribution to the mechanization of the farm came from the invention of the internal-combustion engine. Used first of all to drive stationary machinery, as chaffcutters, root cutters, and corn mills in the barn, in the second decade of the 20th century the internal-combustion engine also made headway as a source of power for field operations. Steam engines, though widely used for traction on the road, suffered the disadvantage of being heavy for use on the land for the direct haulage of machinery and implements; it was not until the internal-combustion engine had been perfected that agricultural tractors made their appearance in any number.

This type of tractor has (1945) an established position on the farm on both sides of the Atlantic; it supplies power for plowing, cultivating and harvesting; it can both drive and haul the threshing machine, and there can be no doubt it contains the promise of still further usefulness. The practice of mole draining,

for example, was greatly stimulated, not only in Great Britain but on the continent of Europe, by the invention of mole plows that can be hauled by a suitable agricultural tractor The cost of the work is substantially less than when performed by steam tackle and is far more expeditious than when performed by horses. The tractor has also rendered it easier for the farmer to undertake deep plowing and subsoiling, which are very important for growing a crop such as sugar beets. Subsoiling had been looked on with disfavour because of the heavy strain imposed upon the teams and, when carried out at all, had been left in great measure to steam tackle. The application of the internal-combustion engine also enabled designers to produce machines of more moderate size and weight than formerly. Another direction in which the internal-combustion engine is likely to prove its usefulness is in rotary tillage.

The internal-combustion engine enables operations to be efficiently performed which were beyond the resources of the ordinary farmer, or which were little more than ideas in the days of steam and horse labour. But this is not its only or perhaps its chief usefulness. It enables operations to be performed far more speedily with an equal labour force and is therefore an ally to the farmer in his struggle against adverse weather conditions. Obviously, if five or six acres can be [illegible] in a day by a tractor where formerly a plow team [illegible] for less than one acre, another factor than the unit cost of the plowing, namely, that of speed or of the time conditions, has entered into the operations. Again, if 20 acres can be reaped in a day as against 10 or 12 acres by two teams of horses, the same factor enters.

**Electricity.**—But a still newer source of power on the farm is electricity. Because of the shortage of coal and oil fuel during World War I, a stimulus was given to the exploitation of water power and the generation of electricity. Although employed at first principally for lighting, electricity, when it is available at low cost relatively to other forms of power, is gradually coming into use for driving stationary machinery on the farm. Beginning after World War I, there was a rapid increase in rural electrification in many countries of Europe and in the United States. The increase was especially noteworthy in the United States, where in 1944 it was estimated more than 40% of the farms had electricity and agricultural engineers predicted an increase to as much as 75% in the first decade after World War II. The principal new uses developed were for heating chicken and pig brooders and for refrigeration.

**Rise of Farm Mechanization in the United States.**—Because of the rapid development of mechanized agriculture in the United States, special attention is devoted to some of the highlights of its history. During the colonial period (1607 to 1783), farming was on a self-sufficing basis; that is, the farmer made his own shelter, he and his family made much of what they wore, and, with the exception of some wheat, tobacco, rice and indigo, the farmer raised but little more than was required for his own family. The ground was spaded or hoed up, or it was plowed with a crude "bull" plow which carried a wooden mouldboard sometimes stripped with iron. If the seedbed was harrowed at all, a peg-tooth harrow was used; this was a wooden frame with wooden spikes for teeth. Small grain was sown broadcast by hand sometimes it was harrowed in or was trodden in by animals. The new crop was cut with a hand sickle, scythe or cradle, threshed with hand flail or by driving animals over it on a treading floor; then the grain was winnowed by casting it against a light wind. Corn was dropped, covered, cultivated and harvested entirely by hand. Wooden wheeled carts were used. Thus, with the exception of a great number of hand tools, crude forms of the plow, harrow and wagon were the only agricultural implements of the colonial period

With only one or two notable exceptions the same conditions held and the same old implements were used throughout the second period (1783–1830) of agricultural history. Early in the 1790s the Whitney cotton gin appeared; this made the removal of the seed from the cotton fibres mechanically possible and was a great boon to the young cotton industry. The influence of the cotton gin was so far-reaching economically, commercially and socially that it is considered one of the high lights in the history of agricultural machinery.

About 1797 Charles Newbold demonstrated his cast-iron plow It was similar to the cast-iron plows which had been demonstrated shortly before in England. Records indicate that farmers feared detrimental effects from so much iron in contact with the soil, and evidently this first American cast plow was never repaired after its mouldboard became broken. Hence wooden plows, some of which carried wrought-iron cutting edges, continued well throughout the period Between 1814 and 1820, however, Jethro Wood, evidently continuing the mediations of Thomas Jefferson on the mathematics and mechanics of the mouldboard, began to give the plow bottom scientific shape for better turning, pulverizing and for lighter draught. To obtain these shapes Wood had to cast his plows, and he introduced the important feature of having various parts of the plow renewable.

At no time has American agriculture undergone such changes as during its third historical period (1830 to 1860). At the beginning of this period the farmer produced first for himself and family; at the close he was raising crops chiefly to sell.

The obstinate scouring qualities of the soils in the Mississippi valley led to the use of steel instead of iron strips to face the mouldboards of plows. In 1833 John Lane built the first steel mouldboard, using crosscut saw blades for the purpose. John Deere starting in 1837, and William Parlin beginning in 1842 were other pioneers in the steel plow business of the middle west. Much credit is due also to James Oliver who, beginning his experiments in 1853, greatly advanced the process of chilling cast plow parts, thus securing greater durability and improving the scouring qualities of this type of plow

Early in the '30s the Manning, the Hussey and McCormick patents brought out the idea of cutting grass and grain by a reciprocating knife passing through fingers or guards. It is this principle upon which modern mowers, binders, headers and combination harvester-threshers still operate.

By 1850 several factories had been established for the manufacture and sale of what were then improved and successful plows, harrows, grain drills, reapers, mowers, threshers, strippers and power sweeps. Of course much work on the farm still had to be done by hand, and much improvement and many new devices were to appear after that date. But by that time the farming public was accepting mechanical devices so rapidly that 1850 is recorded by historians as the close of the period of "hand production" and the beginning of the machine era in American agriculture. The advent of machinery and implements placed farming on a commercial basis on which the farmer raised products to sell rather than simply to sustain himself and family. It is interesting to note that from 1850 to 1860 the number of establishments manufacturing agricultural machinery increased from 1,333 to 2,116.

From 1850 to 1860 patents appeared and there was development work on each of the following: force-feed devices in grain drills, stalk cutters, baling presses, two-row corn planters, disc harrows, feed grinders and "straddle row" cultivators. Improvements continued on all classes of implements, especially on mowers, threshers and reapers. One of the most interesting developments concerned mechanical binding attachments made for and used to some extent on reapers.

The fourth period in the history of American agriculture extends from 1860 to 1887. It was characterized by remarkable expansion, a chief cause of which was the passage of the homestead acts. The disbanding of the armies of the Civil War sent men and mules back to the land, and, machinery being available, many sought the agricultural opportunities of the far west which was about to be opened up by the completion of the transcontinental railroads. The perfection of the twine binder and the introduction of the roller process for flour manufacture also stimulated agricultural expansion.

The drain of the Civil War on farm labour forced farmers to the use of more and more machinery. During the war, mowers came into very general use, and early in the period much was done to perfect horse rakes, which, as an accompaniment to the

mower, could displace more labour in the haying process. This was to be followed soon, in 1872, by the development of hay forks, slings and carriers by which hay could be moved from the wagon to the mow or to the stack by horse power rather than by hand. Thus the production of hay became mechanical save for one step—that of loading. This gap began to be closed in 1874 when the mechanical hay loader appeared; the implement was considerably improved about 1880 and came into use about 1885 Although they had been patented years previously, two-wheeled sulky and gang plows did not appear in good quantities until about 1870.

The first automatic grain binder—that is, the first harvester of the Marsh type to carry an automatic bundle forming, compressing and tying attachment—appeared in 1870, and was known as the Locke machine. At last the tedious process of binding sheaves by hand was doomed, and the importance of this development in the history of agriculture can hardly be overestimated. Attachments using twine as the binding material, and some using wire, followed quickly. About 1878 the famous tying device known as the Appleby knotter appeared. It became the standard tying mechanism of nearly all modern grain, rice and corn binders. Thus the grain binder was the result of 40 years of struggle.

Although combination harvesters and threshers had been thought of as early as 1826, it was not until about 1875 that the combine came into use, and then it appeared in the vast wheat fields of the Pacific coast states. These were large machines, drawn by from 12 to 30 horses, cutting a swath of grain from 16 to 24 feet wide, and threshing, cleaning and sacking the grain in one trip over the field.

In 1875, largely through the activities of the Haworth brothers, automatic checkrowers for planting corn became practical. The dropping mechanism in these machines was operated by regularly spaced buttons or knots on a wire stretched across the field, instead of by an extra man on the planter. Thus one man, and the previous operation of marking off the field were eliminated from the planting process. In 1876 manure spreaders of the wagon type were developed to the practical stage. About the same time ensilage cutters, or silo fillers and disc plows appeared, the latter, however, did not become commercially practicable until about 1890. Although stationary steam engines, and steam engines on trucks which could be hauled from place to place had been used previously, the self-propelled steam traction engine did not appear in agriculture until about 1880. This was the forerunner of the modern tractor. In 1884 three-wheeled sulky and gang plows were developed. About 1885 a combination machine for husking corn and shredding the stalk made its appearance.

The fifth period in American agriculture, 1887 to about 1940, began with the practical exhaustion of those public lands in the United States which could be converted easily and cheaply into quick producing farms. After 1887 agriculture had been settling down to more intensive cultivation accompanied by improvement in farms and the subsequent rise in land values. (The same tendency is in evidence in Canada, though there the corresponding periods are from 10 to 20 years later.) Obviously attempts to intensify and diversify agriculture involved machinery and implements in no small way.

The period opened with many of the most fundamental types of agricultural machinery well established. Minor improvements continued in all classes of implements. Sled corn harvesters, corn binders and side delivery rakes to facilitate loaders came in early in the period. These were great labour savers. Inasmuch as one man with three horses on a two-row cultivator can cultivate 90% more acreage per day than one man with a single-row machine, it was only natural that attention should be given the two-row cultivators which began to appear early in the '90s. About 1890 the Babcock device and system was developed for determining the butterfat content of milk and cream. The Babcock test helps the farmer cull the unprofitable cows from his herd. Cream separators appeared about 1890, and a great labour saver, the milking machine, came into use about 1910.

Among the early attempts to adapt the internal-combustion engine to farm work no efforts stand out more prominently than those of C. W. Hart and C. H. Parr, two young men who developed very satisfactory, stationary, gasoline (petrol) engines as early as 1896. A little later they conceived the idea of mounting a gasoline engine on a truck, and gearing the two together so that the combined unit would propel itself. In 1902 these men built such a machine and proved that the gasoline engine could be used for haulage purposes. A new industry, the great modern tractor industry, was born. Manufacture began almost immediately by several companies, and within nine years a large number of tractors were plowing, harrowing, seeding and threshing in those regions of the United States and Canada where the farms and fields were large. These early tractors were large, heavy and somewhat crude. Being able to develop 30, 40 and sometimes 50 horsepower at the drawbar, they pulled six-, eight-, ten- and twelve-bottom plows, or large combinations of soil preparation and seeding implements.

The tractor had demonstrated its ability to get work done quickly with a minimum of human labour, and, in farming, getting work done when weather, crop or soil is right is a decided advantage. The old heavy tractors, however, required considerable outlay in cash, and they were too unwieldy for practical use except in large fields. About 1910 the power [illegible] d so thoroughly gripped agriculture that suddenly a demand for small tractors developed from farmers on smaller tracts, and many of the old manufacturers, together with a great number of new tractor concerns, began bringing out smaller tractors. This tendency to cut the size, power, weight and price continued until the light tractor of 8–16 and 10–20 horsepower came onto the market about 1916 and brought with it the light, two-wheeled tractor plow which was quite an innovation in plow design. The light tractor and light plow, selling at prices which made their use economical on small farms, introduced power farming onto thousands of farms in both the United States and Canada, farms which could not have enjoyed their advantages had not smaller, cheaper units been made available. Likewise, small sizes of grain threshers, of ensilage cutters and of feed grinders became popular because the presence of the small tractor on the farm enabled the farmer to perform these respective operations himself instead of having to depend upon the custom outfit which previously had passed from farm to farm doing belt work for hire. By 1944 the United States had 2,000,000 farm tractors, mostly of the handy size, and in Great Britain during World War II the number increased from 55,000 to 160,000 by 1943.

Another major development in the current period of agriculture is the mechanical corn picker. Such a machine was talked of in 1851; some were built and successfully operated about 1910, but not until about 1920 did it really start to take its place in the corn belt. Likewise, rotary hoes, for rapid corn cultivation, were in 1928 just beginning to become popular, although they had been on the market for 20 years.

Although the motor truck is not strictly a farm machine it has proved to be one of the most helpful to farmers. In the U.S. it was estimated in 1944 that 1,100,000 were used on American farms, mostly lightweight ones of the pickup sort.

Among the noteworthy developments in farm machines during the 1930s and '40s were improved planters of various kinds, some very special ones such as machines for planting "sheared" sugar-beet seed, specially cut down so as to produce more single plants and reduce the work of thinning; then there were also many new designs of planting plates, particularly those for planting seed and hybrid corn, including the irregular butt and tip kernels (worth saving when the price is high) and those for planting the very small seeds of some vegetables such as turnips, radishes, cabbage, etc. At the same time devices were developed to make feasible aeroplane planting of rice in California.

In this same period many new harvesters appeared such as the corn picker-sheller, the self-propelled combine harvester-thresher, very small combines for many crops and small farmers, and there were many crop varieties developed with the idea of fitting them better to machine harvesting, for instance, bush snap beans that would produce much of the crop at one time so the plants could be pulled and taken to a machine for picking off the beans, thus

saving hand labour.

The development of new planters and cross-blocking machines for sugar beets was noteworthy as a combination of efforts to produce a good yield while at the same time eliminating much heavy labour. There was considerable development of flame weeders, especially in sugar-cane fields. There was a decided tendency toward more surface cultivation in contrast to deep cultivation. This meant greater use of such tools as duckfoot cultivator shovels.

Significant changes came in ways of fighting insects and fungi. One of these was the aerosol method of spreading, which, at least insofar as field crops were concerned, was still experimental in 1944. The method is to use a highly volatile chemical liquefied under pressure in a steel cartridge and containing the insecticide or fungicide. Opening a valve causes automatic spreading. Such equipment was widely used by military forces during World War II for control of flies and mosquitoes. In addition new insecticides, fungicides and materials for control of nematodes appeared. Machines were made for applying picric acid and "DD," a petroleum by-product, to the soil to kill nematodes.

**Manufacturing.**—As the farmer found increasing need for more complicated machines and more different kinds of tools and machines with greater variety in agriculture, the manufacture of farm machinery became a great industry, especially in western Europe, Great Britain, the United States, and, after 1920, in Russia. In most other parts of the world the manufacture of farm machines is of only minor and local importance, except perhaps in Canada, South Africa, Australia and New Zealand where considerable numbers of machines are made. The United States is the largest user and the largest producer of farm machinery.

In all the progressive agricultural countries the value of farm implements on farms increased rapidly after 1850 and even more rapidly after 1900, with the widespread adoption of mechanical power for both field and stationary work. As a result of the demands of war, values of machinery on farms receded, but at the same time more thorough use has been made of the implements available. During World War II the practice of pooling farm machines became common in many countries and old machines were brought back into use through repair work and replacement of parts.

One factor of great significance is the rapid increase in durability of many machines, the result of improved materials such as alloy steel, better design and more effective lubrication. These factors no doubt accounted in great degree for the extra wear obtained from farm machinery in wartime.

Credit for the improvements in farm machines during the modern period is not only due to the scores of inventors such as Jethro Tull, Eli Whitney, Obed Hussey, Cyrus Hall McCormick and John Deere, but also to the improvers of steel, the manufacturers and their laboratories, and government and private agricultural research institutions. Through such organizations as, in the United States the American Society of Agricultural Engineers there has been close co-operation that has speeded developments.

Improved steels really made it practicable to have farm machines move faster in the field, such as mowers, binders, combines and other harvesting machines. These new materials have made it possible for manufacturers to reduce the weight of many implements and to produce more durable parts such as mouldboards of plows and the shovels of cultivators.

Changes in design, of course, have been frequent. Some of the more outstanding have been: changes in plows which provide more space between the mouldboard and the beam, thus reducing the tendency to clog with trash; plow jointers that tend to avoid obstructions and return to the original line of travel, thus reducing draught; enclosed gears that require infrequent lubrication and wear long because they are kept clean; forced lubrication on some of the more complex machines; planting plates and other seed-spacing devices that greatly improve accuracy of plant placement and cut down later labour in tending the crop. These are but a few of many examples that may be cited.

In 1933 the American Society of Agricultural Engineers published a report of a survey made by a group of eminent agricultural engineers on "changes in the quality values of farm machines over a 20-year period (1910–14 to 1932)." These changes in quality values, the result of various factors, were expressed simply in figures by letting 100 represent the quality value at the beginning of the period and then arriving at a figure for the increase in value resulting from various changes. Twenty-five machines were studied in this way.

The index of quality value of the grain binder (horse-drawn), for example, rose from 100 in 1910–14 to 170 in 1932. This estimate of increase in quality value in this one machine was based on 65 engineering developments which were listed in the report A few of the developments mentioned were: binder driving shaft changed from 10 to 30–40 carbon steel, knotter frame strengthened, heavier teeth in main gear and pinion, and knotter hook made of steel rather than malleable iron.

Following is a list of the other 24 machines and the quality index figure for comparison with the base of 100 representing the quality value of 20 years before: cultivator (single-row riding, pivot wheel), 165; farm engine (gasoline), 200; disk harrow (horse-drawn), 190; peg-tooth harrow, 130; spring-tooth harrow, 140; hay loader, 155; mower (horse-drawn), 170; corn picker, 210; corn planter, 155; tractor plow, 190; gang plow (two-furrow, horse-drawn), 150; walking plow (one-horse), 140; walking plow (two-horse), 140; sulky rake, 135; side-delivery rake and tedder, 140; cream separator, 145; corn sheller (power), 190; corn sheller (two-hole hand or power), 190; sheller (one-hole hand), 170; manure spreader, 180; grain thresher (steel), 195; feed grinder, 175; ensilage cutter (or silo filler), 215; and spraying machine (two-nozzle), 175.

Many improvements have been brought about in farm machines after the making of the survey on quality values. Experience has shown that technical improvements in all sorts of mechanized equipment are sooner or later reflected in better farm implements. Because of the high pressure exerted for improvement of mechanical equipment of many kinds during war there is usually a period of varied and rapid change following hostilities.

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(C. E. GN., R B. G)

**AGRICULTURAL PRICES.** Prices of agricultural products were of little importance when agriculture was virtually self-sufficing. They are of paramount importance to the typical commercial farmer of today, who sells most of what he produces and buys most of the things he needs for family living as well as many of the things he uses in production. The relation which prices of agricultural products bear to the farmer's living expenses and his expenses of production are of primary importance in determining not only the welfare of agriculture but also what farmers will produce and how much.

From the historical standpoint, special interest in agricultural prices centres on (1) the development of markets and methods of price determination, and (2) the periods of agricultural price depression and prosperity which have resulted from changes in agricultural and other prices.

**Development of British Markets.**—In the early stages of English agriculture the mass of producers were content to satisfy their own wants and were practically indifferent to outside trade. Later, however, the need arose for some machinery for bringing buyers and sellers into touch, and this was met by the institution of fairs and markets held at fixed places and periods. These in the first instance no doubt arose spontaneously, but it speedily became apparent that the holding of a fair or market in a town could be made a source of profit to the burgesses, or if there were no sufficiently [illegible] community, to the lord of the manor. Thus arose a system of tolls on goods exposed for sale in the market. The crown, exercising its authority as overlord, saw at once an opportunity of revenue and claimed and exercised the right to forbid the holding of a fair or market except under royal charter, which was granted on terms. Tolls and regulations of the market would tend to raise the price level, but the effect could only have been slight.

A more serious effect on agricultural prices was caused by legislation against the practices of badgering, forestalling, engrossing and regrating, which was passed in the early part of the 16th century and did not disappear from the statute book until late in the 18th century. The purpose of this legislation in restraint of trade was to protect the consumer from trade practices which were presumed to raise artificially the price of food. A "badger" was a dealer in food who bought in one place and sold in another. He was licensed for a year and was under recognizances against forestalling, engrossing and regrating. Forestalling was purchasing food on the way to market with intent to sell it at a higher price; engrossing was attempting to control—in modern phraseology to "corner"—the market by buying up all the food for the purpose of exacting higher prices; regrating was the resale of food previously bought in the same market.

The state for many centuries intervened directly in the regulation of the price of wheat and bread. From the Norman conquest to the reign of Henry VI the exportation of wheat was prohibited, although in earlier times it had been common. Importation was unchecked, although there is no record of it until the 14th century. In 1436 an act was passed authorizing the exportation of wheat whenever the price did not exceed 6s. 8d. per quarter and in 1463 the exportation of corn was forbidden until the price exceeded that at which exportation ceased. Thereafter a succession of enactments were passed some giving a bounty on exports, others imposing a duty on imports, or adopting both methods under limitations of prices. In 1774 an act was passed permitting imports at a nominal duty of 6d. per quarter when the price reached 48s. and forbidding exports unless the price was below 44s. when a bounty of 5s. per quarter was given on exports in British ships.

Up to this time legislation had for its main object the interests of consumers while attempting also to have regard to the interests of producers, and also to encourage shipping. In 1791 the first of a series of acts was passed which, with increasing stringency, aimed mainly at protecting the interests of home wheatgrowers, which continued until the repeal of the Corn Laws in 1846.

In the 13th century the Assize of Bread was established, by which the duty was imposed on justices of the peace of adjusting the weight, quality and price of bread to the current prices of wheat. The system was modified in detail from time to time, but continued in force until 1822 in London and until 1836 in the provinces.

In later times the establishment of great markets in the large centres of population did much to determine prices on the basis of general and not of local supplies. Many of the markets developed from local to national importance by reason largely of their position in relation to means of communication. Covent Garden is a notable instance. It was originally a place where growers of fruit and vegetables in the vicinity of London could dispose of their produce direct to retailers and consumers. The convergence in the metropolis of the main lines of railway made it a national distributing centre, serving, through various channels, all parts of Great Britain, and "Covent Garden prices" became the standard of values throughout the country.

The organization of commercial price-making on a national basis had, however, scarcely been completed when a new factor was interposed which speedily changed the basis on which price levels of some of the principal foodstuffs rested. Imported wheat, meat, cheese, butter and other kinds of agricultural produce were sent to the British markets in ever-increasing quantities. As they increased in bulk and improved in quality their influence became so great that prices in the wholesale markets were determined on an international rather than on a national basis.

The most prominent instance of this modern development is to be found in the wheat trade, where imported grain, forming as it does about four-fifths of the whole supply, dominates British prices and determines the value, at any given time, of British wheat

Price-making arrangements in the wheat trade are highly organized. World's prices are practically settled at four great markets, viz., Chicago, Winnipeg, Liverpool and London, and so well adjusted and sensitive is the mechanism that fluctuations in one are immediately reflected in the others.

**Prices in America.**—Prices have been important to American agriculture ever since early colonial days. Although the agriculture of the frontier regions was always largely self-sufficient, much of the total output was for sale either in the domestic or the export market. As the frontier was pushed westward into the fertile valley of the Mississippi. an ever-growing volume of agricultural products was shipped either down the rivers or eastward to the older settlements to be exchanged for all kinds of manufactured products. This rapid growth of agricultural production in America during the 18th century also had a profound effect upon prices throughout the commercial world. Cheap food and cotton from America was basic to both the growth of manufactures in Britain and to the decline in British agriculture.

Throughout most of the history of the United States, the determination of prices of agricultural products has been left to private competitive enterprise in the market places. Tariffs and other government regulations have had their influences, but the actual process of price determination has been left almost entirely to the bargaining of private enterprisers. The most notable exception was during World War II, when price ceilings were

established for most farm products as well as for other products Nevertheless, prior to the war there had been a growing government participation in the process of agricultural price determination. The Federal Farm Board, through its loan and purchase operations from 1929 to 1933, had an important influence. The Commodity Credit corporation, operating on a larger scale, was a much more important market factor from 1933 on. These loan and purchase operations, together with the influence of the Agricultural Adjustment administration and the soil conservation service upon agricultural production, indicate that the United States has been moving toward a degree of control over agricultural prices comparable to that attained by some European countries a decade or more earlier.

**The Course of Agricultural Prices.**—Agricultural prices in the United States from the beginning of the 19th century have been influenced by four periods of inflation. The first was due to the War of 1812, the second to the Civil War, the third to World War I, and the fourth to World War II. After each inflationary peak there has been first a sharp decline and then a rather long period in which the general trend of prices has been more slowly downward. In a general way the prices of agricultural and nonagricultural products moved together. However, over the entire period agricultural prices have risen relative to the others—owing to the less rapid improvement in the arts of agricultural production.

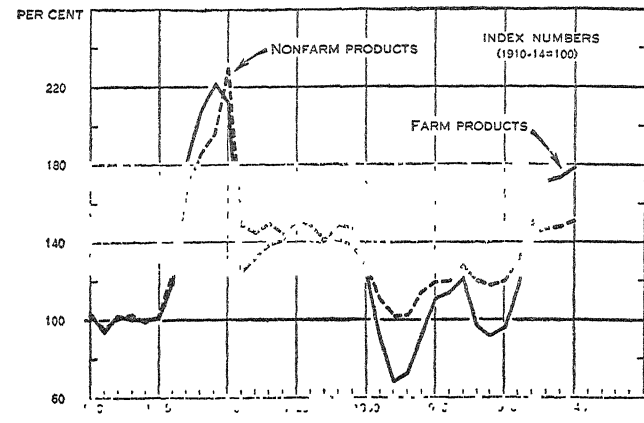
Price changes in England have been somewhat similar to those in the United States, but in England there was no price inflation corresponding to that during and immediately after the Civil War in the United States. Instead, there was a period of gradually rising prices and of agricultural prosperity from about 1850 to 1872. This was in contrast to the long period of falling prices and chronic agricultural depression which had prevailed for about thirty years following the Napoleonic Wars.

From about 1873 to 1895 agricultural prices declined gradually not only in the United States and in England, but also in other countries whose currencies were maintained at a constant level in relation to gold. In England rents fell and marginal land went out of cultivation. In the 1890s, a British Royal Commission stated, "We have no hesitation in expressing our entire concurrence in the opinion that the crisis in agriculture is due primarily to the fall in prices."

Conditions in the United States during the latter part of the 19th century differed greatly from those in England. The area under cultivation was constantly expanding. In the newly settled areas, rents and land values tended to rise at times because of improvements in transportation and in methods of agricultural production, especially the greater use of machinery. For the older settled regions of the United States, however, conditions bore much more resemblance to those in England. Even in the West, where many of the pioneers pushed on from one new frontier to another, exploiting the virgin soil resources as they went, agriculture was not very prosperous because of the declining price level.

The course of wholesale prices of farm products and nonagricultural products in the United States is shown by the accompanying chart from 1910 through 1945. There have been few times from 1920 when the prices of farm products have been as high relative to nonagricultural products as they were in the base period, 1910–14. If the comparison is made between prices received by farmers at their local markets and the prices paid for the goods they buy at those markets it is still more unfavourable to agriculture. Increases in freight rates and other marketing costs widened the spread between local market and central market prices and resulted in an increase of retail prices relative to wholesale prices. As a consequence, there was no time from 1921 to 1941 when the index of prices received by farmers was as high relative to the 1910–14 base as was the index of prices paid, interest and taxes.

**Parity Prices.**—The disparity between prices received and prices paid by farmers was generally viewed by agricultural leaders in the United States as the primary cause of agricultural distress from 1920. Parity, or the level at which prices of farm




COURTESY, U S DEPT. OF AGRICULTURE

WHOLESALE PRICES OF FARM PRODUCTS AND OF ALL COMMODITIES OTHER THAN FARM, UNITED STATES, 1910-45

products would be as high relative to the prices of things farmers purchased as they were in 1910–14, was widely accepted as the proper goal of agricultural programs. At first the term parity was applied only to each individual farm product. The parity principle as applied to individual commodities became a part of the Agricultural Adjustment Act of 1933 and has since appeared regularly in laws relating to agricultural aid and prices of farm products. The desirability of maintaining prices of individual products at the legal parity has been questioned by economists because the formula does not make allowance for changes in costs of production, in size of crops, or in other things which affect the normal prices of commodities.

**Differences Between Countries.**—In most countries of the world prices of agricultural products rose during World War I. The extent of the rise and the timing of any subsequent decline depended upon the extent of the inflation and when that inflation reached its peak. The course of agricultural prices in England was fairly similar to that in the United States, but the rise was greater and the decline of the early 1920s was less precipitous and longer continued. In Germany, agricultural prices shot upward under the influence of a postwar hyper-inflation until the end of 1923, when a new currency was established having the same gold equivalent as the old mark. In France, after a temporary decline in 1921 and 1922, prices continued to rise until 1926 when the franc was stabilized at about one-fifth of its former gold value.

Differences in the movement of agricultural prices in the various countries during and after World War I were primarily dependent upon monetary—including credit and foreign exchange—conditions which affected the value of the particular country's currency. Most countries, however, experienced one or two periods of severe declines in agricultural prices at some time between 1919 and 1932. In many countries, however, agriculture did not suffer during the 1920s from prices which were low relative to those of industrial products.

As a result of World War II there were again rapid increases in the prices of agricultural products in most countries of the world. Government price controls were soon resorted to in almost all countries. The degree of effectiveness of the controls varied greatly, as did also the difficulty of the problem of holding inflation in check. The potential inflation as measured by the increase in bank credit and money supply was generally much greater than during World War I, yet through 1945 price increases were less than during the 6½ years following the outbreak of the previous war.

**Factors Affecting Prices.**—Since about 1920 a great deal of attention has been devoted by economists to statistical and other studies of the factors affecting prices of agricultural products. These include analysis of the prices of individual products, of the relation of agricultural prices as a group to prices of other commodities, and studies of the general price level. Studies of individual products, and even of agricultural products as a group, have been quite successful in arriving at quantitative measurements of the influence of various factors upon prices. Studies

of the general price level have been less successful, not because of inability to measure the numerical relationships involved, but because clear evidence is often lacking as to the causal connections.

It is apparent, nevertheless, that whatever are the monetary and other influences responsible for changes in the general level of prices, these same factors have been important causes of the variations in prices of all agricultural products since 1914. In addition, prices of agricultural products have been largely influenced by changes of industrial production and employment—that is, by changes in the general level of "real" demand. Finally, prices of the individual products have been greatly influenced by various factors which relate specifically to the commodity itself, such as supplies of the commodity and of competing commodities.

Much of both year-to-year and seasonal price fluctuations of agricultural products is occasioned by variations in the weather, but there are also important fluctuations which are the consequence of shifts in agricultural production in response to price changes themselves. Cyclical variations in hog prices are an important example of the latter. (E. J. Wg.; R. H R.)

**AGRICULTURAL RESEARCH**, if broadly defined, may be said to have begun when primitive man commenced to observe his experiences with crops and livestock and to interpret his findings with resultant improvements. In modern times it is limited to the manipulation of things, concepts or symbols, with a view to formulating generalizations which verify, correct or extend mankind's knowledge of all processes concerned with agriculture. Such knowledge may facilitate the construction of a scientific explanation or promote the practice of actual farming. Thus defined, agricultural research encompasses all work in the natural and social science fields that are concerned with or affect agriculture.

In Graeco-Roman times the art of agriculture reached a comparatively high state of efficiency, but this development was based upon centuries of observation and experience rather than research. Scarcely any progress was made in deriving true scientific explanations of the chemical, physical, and biological processes involved in agriculture. The Greek love of speculation gave rise to numerous physical theories, but the validity of these systems could only be established by experimentation. For this mankind had to wait for more than 1,000 years after the disintegration of the Roman empire until Theophrastus Paracelsus (1493–1541) attacked speculative philosophy as the source of knowledge and bid his followers put their faith in experience.

The progress of agricultural research from mediaeval times to the controlled laboratory and field [illegible] of the 19th century was tortuously slow. Its history is [illegible] with that of the modern beginnings of the various sciences and is replete with famous names. Prior to the onslaught of modern industrialization and its accompanying urbanization there was no reason for the segregation of the agricultural part of these sciences or for specialization on distinctly agricultural problems except as determined by the personal interests and experiences of experimenters. For example, the chief contributions of Bernard Palissy (1510–1589), the French craftsman, were in the field of ceramics, and yet his investigation of the nature of soils and fertilizers justifies his being called the founder of agricultural chemistry.

By the beginning of the 19th century the sciences had reached stages of development where further progress seemed dependent on field experiments. Antoine Laurent Lavoisier (1743–1794), who established the foundation of the structure of modern chemistry, conducted numerous experiments on his farm at Blois, France, and prepared reports on his findings with a view to improving agriculture and relieving the poverty of his peasant neighbours. In 1784, Albrecht Thaer (1752–1828), began to turn his attention to agricultural research on an estate near Celle, Germany. In 1802 he converted this estate into an agricultural institute where he lectured on farming. Heinrich Einhof (d. 1808) assisted by teaching the relations of chemistry, physics and mineralogy to agriculture, and many future scientists received their initial training at this institute. In 1804, Thaer was called by King Friedrich Wilhelm III of Prussia to head a new state agricultural institute at Möglin. Another pioneer in the use of field experiments was S. F. Hermbstädt (1760–1833), a professor at the University of Berlin, who, from 1815 until [illegible] investigated the chemical composition of cereals and the influence of fertilizers on the production of the proximate constituents of plants.

The modern aspect of agricultural research began with the field experiments of Jean Baptiste (Joseph Dieudonné) Boussingault (1802–1887). Earlier scientists had developed much knowledge concerning the elementary composition of agricultural products, but no one had sought to [illegible] balance of chemical elements in the growing of crops or in the feeding of animals. It remained for Boussingault to seek scientific facts in the fields and stables. Following an adventurous career as a mining engineer in South America, he settled on a farm at Bechelbronn in Alsace where he conducted a carefully planned series of field experiments from 1834 until his land became German territory in 1871. By quantitative methods he investigated the changes in the elementary composition of seeds during germination; the assimilation of atmospheric nitrogen by plants; the rotation of crops; the use of fertilizers; the care of barnyard manure; the nutritive value of forage crops; the feeding of livestock; the influence of feed on the yield and composition of milk; and many other practical agricultural problems. These experiments, co-ordinated with laboratory controls, pioneered in the problems of feeding crops and provided the basis of all modern field work. The facts gathered by this and other methods were reduced to order by Justus von Liebig (1803–1873) in 1840 and later in his brilliant generalizations on plant nutrition and crop production.

In Britain J. B. Lawes (1814–1900) began to experiment with artificial fertilizers at his Rothamsted estate in 1836. Formally organized by Lawes and Sir Joseph Henry Gilbert (1817–1901) in 1843, these experiments are still carried on, and thus Rothamsted ranks as the oldest agricultural station in continuous operation. The effects of their artificial fertilizers on the soils of Britain were so striking that similar experiments were soon made in most countries with mature agriculture. Although the results were not always as clear and definite as in Great Britain, the experiments opened the way to new knowledge of soils, crops and livestock In the United States where water supply was often a limiting factor in crop production, these experiments led to important developments in soil physics; in France, to the important contributions of Georges Ville (1824–1897) on the use of fertilizers; and in Russia, to far-reaching studies of soil morphology. Animal nutrition was also studied by Lawes and Gilbert at Rothamsted, but considerably developed in Germany.

In due course [illegible] and experiment stations were founded as research centres in almost every civilized country. Eventually most countries also created departments of agriculture in their governments which conducted extensive research as well as supervisory and regulatory work. The needs of World War I compelled rapid integration of special studies and emphasized the desirability, if not necessity, of a higher degree of co-operation and co-ordination of research projects, not only within countries and empires, but also internationally. Although impoverished by the war, the European countries extended their organizations for agricultural research in the 1920s and 1930s, and eventually most countries had experiment stations owned and financed by the state; frequently others were financed by private grants, agricultural organizations, or trusts. World War II brought further and greater recognition of the contributions of agricultural research in its many fields to the welfare of mankind.

In Britain parliament provided the development fund in 1909 at the instance of David Lloyd George and assigned a capital sum of £2,000,000 for rural development, including agricultural research and education. It was decided to make grants to existing institutions, holding each responsible for certain fields of agricultural research, rather than to create new stations to cover all fields. The main subjects and the institutions to which they were assigned are: Soils, plant nutrition, and plant pathology at Rothamsted Experimental station; animal nutrition at the Rowett Research Institute, Aberdeen; plant physiology, at the Imperial College of Science and Technology, London; plant breeding at

Cambridge university, the University College in Aberystwyth and the Scottish Plant Breeding station in Edinburgh; fruit research at Long Ashton, Bristol and at East Malling, Kent; the glasshouse industry at Cheshunt, Herts ; animal breeding at Edinburgh university; dairying at Reading university, the Royal Veterinary college in London, and the Scottish Animal Diseases Research association; animal parasitology at the London School of Hygiene and Tropical Medicine; and agricultural economics and engineering at Oxford university. The development fund was augmented in 1921, and additional aid was provided through the Empire Marketing board established in 1926. The agricultural societies continued also to make grants.

In Canada one single result of agricultural research, namely, Marquis wheat, has long since repaid all expenditures for experimentation in the commonwealth. A school of agriculture, eventually affiliated with Laval university, was established at Ste. Anne de la Pocatière, Que., in 1859; the Ontario Agricultural college, founded at Guelph, Ont., in 1873, carried on experimental work; and Prince Edward Island had a government stock farm at an early date. It remained, however, for the Dominion Experimental Farms system, established in 1886 after an extended investigation of agricultural conditions by a select committee of the Canadian house of commons, to provide most of the research needed by a vast country with widely varying agricultural conditions and problems. Under the first director, William Saunders (1836–1914), the Central Experimental farm was located at Ottawa and the original branch stations at Nappan, N.S., Brandon, Man., Indian Head, Sask. and Agassiz, B.C. Eventually 29 other stations and about 200 illustration stations were added to the system.

In Australia, the wheat-breeding work of William J. Farrer (1845–1906) at Lambreg, New South Wales, and of his continuators at other stations, contributed much to arable farming. Special attention has also been given to pastoral problems. The Waite Agricultural Research institute, established at Adelaide under A. E. V. Richardson in 1924, began a wide range of planned experimentation, and the Council for Scientific and Industrial Research, created by parliament in 1925, provided federal funds and co-ordination for all stations within the commonwealth. In New Zealand, the privately-endowed Cawthron institute was established in 1915, to supplement the work of the state experimental farms and the colleges. In India, the central station, started at Pusa in 1903 with a gift from Henry Phipps, an American, and removed to New Delhi after an earthquake in 1934, was supplemented by state and college stations.

After World War I notable progress was made in other tropical regions. The Imperial College of Tropical Agriculture was opened in 1922, at Trinidad, for training and research in tropical agriculture. The research institute originally founded by the Germans at Amani, in Tanganyika, was reopened and expanded. The veterinary research station at Onderstepoort, South Africa, early won world recognition as the leading centre in its field. The stations at Gezira and Medani in the Anglo-Egyptian Sudan concentrated on cotton and crops used in rotation with it. The growers also organized and financed experimental work; the Rubber Research Institute of Malaya and Tea Research Institute of Ceylon are examples.

The researches of the separate parts of the British empire were conducted independently of the rest until 1927, when an imperial agricultural research conference recommended that the governments of the commonwealths establish on a co-operative basis bureaus to collect, collate and disseminate information on research in selected branches of agricultural science and generally to assist research workers in the empire with data relevant to their subjects. These bureaus are financed from a common fund supplied by the governments in agreed proportions and governed by an executive council with equal members. The bureaus are located in Great Britain at research centres specializing in the respective sciences as follows: Soil science at Rothamsted, Cambridge; animal health at the Veterinary Laboratory, Weybridge; animal nutrition at the Rowett Research Institute, Aberdeen; plant breeding and genetics at the School of Agriculture, Cambridge; pastures and forage crops at Aberystwyth; horticulture and plantation crops at East Malling, Kent; animal breeding and genetics at Edinburgh; and agricultural parasitology at St. Albans. In 1933, the council also assumed financial and administrative responsibility for the already established Imperial Institute of Entomology in London and the Imperial Mycological Institute at Kew. In 1936, a forestry bureau was located at Oxford and one for dairy science at Reading.

In Denmark, the intensive agricultural system which gained the admiration of the world owes much to agricultural research. After their military defeat by Germany in 1864, the Danes sought, as one of their distinguished statesmen said, "to gain within their borders what they had lost without." For many years the Royal Danish Agricultural society contributed to the advancement of agricultural science by appropriations and continued to serve as an important agency to this end after the organization of a department of agriculture in 1896. The dairy investigations, notably the feeding experiments of N. J. Fjord, at the Royal Agricultural college, Copenhagen, were started in 1872. Its laboratories also conducted feeding experiments with pigs, investigations of animal diseases and testing apparatus used in dairying. Although this institution remained the main centre of research, five other stations and a few substations were established for work on soils, plant pathology, horticultural crops and plant breeding. The Danish Heath Society has aided in the reclamation and forestation of new lands. Economic research on co-operatives and marketing also contributed to the advancement of the country's agriculture

In France, a large number of research centres continued the practical example of Boussingault. The agricultural college at Grignon, founded in 1827, was long concerned with agronomical problems. The experiments of Ville, from 1848 to 1863, were made at Vincennes, near Paris. The Station Agronomique de l'Est, founded by Louis Grandeau at Nancy in 1868, emphasized soil investigations. The station at Montpellier studied the vine and its diseases and pests. The Institut Pasteur, although not an agricultural agency, conducted research in plant physiology and microbiology of great importance to agriculture. Soil bacteriology (*q.v.*) began in France as the result of investigations by J. J. Schlosing (1824–1919) and Achille Müntz (1846–1917); other fields were opened up by M. P. E. Berthelot (1827–1907). The striking advances made by S. N. Vinogradsky (1856–1946), who introduced new concepts and more precise methods, made the subject a science. Although the agricultural stations and laboratories were long under the general direction of the ministry of agriculture, they were reorganized into a more comprehensive and centralized system under the institute of agricultural research in 1921 as an office of the ministry of agriculture.

In Germany, an agricultural college was founded at Hohenheim in 1817, but the country had no permanent experiment centre until 1851, when the Economic Society of Leipzig started the station at Möchern in Saxony under Emil Wolff. Similar stations were soon opened, but the most rapid expansion came after the federation of the German States in 1871. Most of the stations were attached to universities and under close government control; they also had certain responsibilities in the regulation of fertilizers, feeds and seeds. In 1888, an association of experiment stations was formed to secure uniformity in methods of investigation and inspection of articles. By the 20th century, the German stations had increased in number and size and had won world-wide recognition. Certain of them contributed to the enormous strides made in the output of synthetic nitrogenous compounds. Among the larger state institutions were those at Halle for animal nutrition, agricultural chemistry and microbiology; at Bonn-Popplesdorf, Königsberg and Landsberg, for soils, plant nutrition, animal husbandry and plant physiology; at Bremen and Landsberg for moor culture; at Breslau, Hohenheim and Göttingen for agricultural chemistry and bacteriology; and at Berlin and Leipzig (Möchern) for many fields of agricultural science. In addition, the nitrogen and potash syndicates and the superphosphate manufacturers maintained private research laboratories.

The Netherlands has several experiment stations which have specialized on the country's particular problems. The station at Wageningen, begun in 1877, is the largest and is especially notable for the work of H. M. Quanjer in plant pathology and D. J. Hissink in soils. The Netherlands has also won commendation for the admirable research work carried out at Buitenzorg in Java and elsewhere in the Netherlands Indies where scientists pioneered in the field of hill culture.

Russia's best-known contributions to agricultural research are in the fields of soil science and plant breeding. The soils work was begun about 1870, under the leadership of V. V. Dokuchaiev (1846–1903), followed by N. M. Sibirtsev (1860–1900) and K. D. Glinka (1867–1927) and others. In contrast with the scientists of western Europe, who analyzed specimens of soils in laboratories, the Russians studied soils in the fields and then supplemented their findings with laboratory data. They concluded that the character of the soil is largely dependent upon its geographical position and climatic environment, and on this basis developed a system of soil classification. Although not widely known outside of Russia until well into the 20th century, the Russian ideas greatly stimulated research in this field. In the work on plant breeding directed by N. I. Vavilov, emphasis was given to thorough exploration of all parts of the world for varieties and breeding material of value and to extensive programs at numerous locations for studying introduced materials in detail and for large-scale hybridization and selection work. Agricultural research in Russia was completely reorganized after the revolution of 1917. The soviet union was reported in 1938 to have had over 14,000 scientists working at 90 agricultural research institutes, 367 experimental stations and 507 experimental farms with numerous branches

The history of the British colonies that became the United States is replete with instances of agricultural experimentation As in all new countries the colonists were obliged to determine by experimental plantings the crops that thrived in the respective localities, and the desirability of encouraging such experimentation through aid from the imperial and local governments was early recognized. A number of distinguished leaders, including John Winthrop, Jr. (1606–1676), William Penn (1644–1718) and Jared Eliot (1685–1763) conducted agricultural experiments. John (1699–1777) and William Bartram (1739–1823) and Humphry Marshall (1722–1801) maintained botanical gardens near Philadelphia, Pa., and a public experimental garden was established at Savannah, Ga., in 1733.

About 1760 George Washington began to study agricultural problems systematically and to make experiments to ascertain the best methods for his Mount Vernon estate and vicinity. Thomas Jefferson gave special attention to natural phenomena in relation to plant growth, introduced plants useful to American agriculture, and made Monticello a veritable experimental farm. For about 30 years, John Beale Bordley (1727–1804) conducted experiments on Wye Island near Maryland's eastern shore, and John A. Binns (1761–1813) devoted two decades to experiments with gypsum in Loudoun county, Va. Beginning in 1785, the efforts of these men and others were facilitated by agricultural societies (*q.v.*), formed for the promotion of agriculture. Among the individuals who made outstanding contributions was Edmund Ruffin (1794–1865), whose essay on calcareous manures has been described as the most thorough work on a special agricultural subject ever published in English. The numerous geological and agricultural surveys during 1820–1857 laid a considerable foundation for the more intensive work of the experiment stations with soils and fertilizers in their relations to plant growth.

Except for special projects, the first federal fund specifically authorized for agricultural purposes was the $1,000 voted the patent office in 1839 for collecting agricultural statistics, conducting agricultural investigations and distributing seeds. With this and later appropriations, an agricultural division in the patent office served as a federal clearinghouse for information on agricultural improvements during the 1840s and 1850s. After long agitation the federal department of agriculture which ultimately became the most extensive agricultural research agency in the world was created by congress and approved by President Lincoln on May 15, 1862. On July 2 of the same year, the bill providing for the establishment of a college of agriculture and mechanical arts in each of the states was signed Beginning in the 1840s steps were taken to establish institutions of research under private and then state auspices, but it remained for the Hatch Act of 1887, augmented by the Adams Act of 1906 and the Purnell Act of 1925, to provide the federal aid that facilitated the development of the national system of experiment stations associated with the agricultural colleges in all the states and territories. To direct the relations between the federal department and the stations, the office of experiment stations was established in 1888. Its publication, the *Experiment Station Record*, has provided abstracts of the reports on scientific research in the U S and foreign countries from 1889.

By the end of the 19th century, discerning leaders throughout the world were becoming increasingly aware of economic and social problems relating to agriculture and farm living The agricultural colleges and the federal department had begun work in this field, and the findings of the Country Life commission appointed by President Theodore Roosevelt served to focus attention on the need of both study and action. In 1913, the federal department was authorized to study the marketing and distribution of farm products. The needs of agriculture during World War I and economic repercussions afterward resulted ultimately in the department's bureau of agricultural economics becoming one of the greatest agencies of research in the social sciences.

Although the stations tended to specialize on the agricultural problems of the states where they were located, leaving to the federal department the investigation of general scientific principles and subjects beyond local means, there was a growing recognition of the need of co-operative action on problems common to several states after World War I. In 1935, the Bankhead-Jones act made special provision for the federal department to undertake scientific, technical and economic research into the laws and principles underlying basic problems of agriculture in its broadest aspects. In the 1920s more emphasis was given to discovery and perfection of new consuming outlets for farm products by the federal department and the stations. Improvements in the sugar industry, the production of casein and the revival of the naval stores industry in the south may be cited as examples. In 1933, a federal laboratory was established at Ames, Ia., to study the industrial uses of agricultural residues like straw, cornstalks, corncobs and hulls. Later a laboratory at Urbana, Ill., began to investigate the possible wider uses of soybeans. In 1938, congress authorized the federal department to extend this type of research upon a comprehensive scale by providing for regional laboratories which were located at New Orleans, San Francisco Peoria, Ill., and Upper Darby, Pa. In 1910, the federal government began to develop what became a national agricultural research centre near Beltsville, Md. By 1945, much of the laboratory and field work of the scientific bureaus of the department of agriculture had been transferred there, and the centre comprised 13,900 ac., 36 laboratory buildings, 31 greenhouses, 100 barns and storage buildings and 500 other buildings.

The interchange of scientific data between the countries of the western hemisphere began in the 1840s, and the need was long felt for inter-American action to carry out research projects which require methodical study and joint action by both the governments and scientists. The first Inter-American Agricultural conference, held in Washington in 1930, recommended the establishment of a Pan-American experiment station to serve this end, and after long negotiation and planning the Inter-American Institute of Agricultural Sciences was inaugurated at Turrialba, Costa Rica, in 1944. Its work was planned to fall in four broad departments: animal husbandry, plant industry and soils, agricultural engineering and economics and rural life.

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**AGRICULTURAL REVOLUTION, THE,** a term indicating that period in history which witnessed the transition of English methods of farming from mediaeval to modern conditions. During the 18th century increasing knowledge and new inventions revolutionized both agriculture and stockbreeding. At the same time the rapid growth of enclosures vastly improved the conditions under which farming was carried on. But it increased the resources of the great landowner to the extinction of the yeoman farmer, and thus an essentially progressive movement in agriculture brought much misery in its train. The expenses incurred by the enclosure movement, the subsequent rise in the value of land, reductions in agricultural establishments, the protective system of the corn laws, and the supplementing of wages from the rates (Speenhamland system [*q.v.*] 1795) raised prices, lowered wages and depressed a large section of the agricultural population to the level of paupers. (*Cf.* INDUSTRIAL REVOLUTION.) *See* also AGRICULTURE: A GENERAL SURVEY; COMMONS; CORN LAWS.

**AGRICULTURAL SOCIETIES AND SHOWS.** In agricultural history there is scarcely a parallel to the enthusiasm that spread through Great Britain during the last quarter of the 18th century. Even George III contributed to Arthur Young's *Annals of Agriculture* and became known as "Farmer George." The politicians, including Fox and Burke, the great landowners, such as the Duke of Bedford and Coke of Norfolk, shared in the zeal and were excited by farming topics and busy with farming experiments. One of the results was the organization of associations for the promotion of agriculture in many parts of the country. Among the earliest and most important were the Bath and West of England society (1777), the Highland society (1784) and the Smithfield club (1798). Another result was the founding of the board of agriculture by Pitt in 1793 with Sir John Sinclair as president and Young as secretary.

A chief activity of many of these societies was the holding of an annual agricultural show. As a rural institution combining exhibit and amusement features it is now found in practically all countries of the western world. In Europe and Australia it is known as an agricultural show, while in the United States and Canada it is usually called a fair. Possibly the earliest local agricultural show was that of the Lancashire society in 1761. The first national show was held by the board of agriculture in 1821.

**The Royal Agricultural Society** was founded in 1838 and received its charter in 1840. Its first show was held at Oxford in 1839 under the presidency of Lord Spencer. The classes for cattle, sheep, horses and pigs were limited, but the names of many famous breeders appeared in the award sheet. Nineteen manufacturers were represented in the implement exhibit. Many had only one entry, but the display by Messrs. Ransomes was extensive. Prizes were also given for essays on agricultural subjects, for skill in plowing and for white and red wheat. From that day the scope of this annual show, as that of most others, has increased, and its form has been closely imitated in the British empire and foreign countries. Although Britain has become overwhelmingly industrial, its agricultural shows are superior in magnitude and excellence to any in the world.

The royal show has always been peripatetic, except in 1903, 1904 and 1905, when it was taken to Park Royal, on the north of London, with disastrous financial results. The prevailing principle in the selection of sites is to alternate populous districts with rural centres. Except when the weather has been unfavourable, the receipts from the first usually enable the society to bear the losses sustained in the second.

Several of the local shows are comparable with the royal shows, though smaller and of shorter duration. A similar variety of exhibit is seen in the shows of the Highland society, the Bath and West of England society, the "Royal Counties" and the "Three Counties" in the Welsh national, and in many of the larger county shows. Many of these, as well as the royal, have attracted large numbers of foreign buyers, especially from South America.

Most of these shows and the societies that sponsored them progressed, with some oscillations, until the depression years following World War I when it became apparent that they were too numerous and elaborate. Although such shows as those of the Suffolk, Lincolnshire and Cornish societies continued prosperous in the 1920s, a movement for the merger of local and county shows began. Yet the breed associations, more in Britain than in other countries, are the backbone of the shows and give no sign of decline.

The great additions to the scope of the shows in the 20th century were made not only with the idea of promoting agricultural science but to draw larger attendance and so provide funds for the proper objects of the societies. The royal show, which continues for five days, may occupy as much space as 100 ac., and the machinery, much of it in operation, is alone a great feature Besides almost all breeds of livestock and poultry, there are exhibits devoted to flowers and forestry, sections on education and science, and displays of rural crafts and the work of the women's institutes. A dairy is seen in action several times a day. Lectures and demonstrations of many sorts are given at intervals, and every afternoon, except on the opening day when most of the judging is done; horse jumping and harness competitions draw large crowds.

The fat-stock shows, held in November and December, and the dairy show, held in London in October, have flourished under urban conditions. As dairying took the lead over corn growing in British farming following World War I, the annual dairy show became a remarkable epitome of the science of dairying and of the quality of the dairy breeds. Of the winter fat-stock shows the three attracting the best entries are held at Norwich, Birmingham and the Agricultural hall at Islington in north London. From the first the Smithfield club has always emphasized the supply and breeding of meat in its London show.

**The Countries of the European Continent** also have vast agricultural shows. Among the more important are the Concours Général Agricole de Paris, the East Prussian Agricultural exhibition, the International Exhibition of the Cheese Industry and Trade of Italy and the General Association of Breeders National show in Spain.

**Agricultural Societies in the United States** were long an important means by which farmers effected mutual help and gained knowledge needed in solving technical problems. There is evidence of several ephemeral organizations of this sort during the late colonial period, but the two oldest of those still functioning (1946), namely the Philadelphia and the South Carolina societies for promoting agriculture, were founded in 1785. The Columbian Agricultural society, which aspired to national leadership, was begun at Georgetown, D.C., in 1809. These societies, together with other local and state groups modelled on them, were pioneers in agricultural education. They provided the public with accounts of the best agricultural practices abroad and the results of experiments conducted by their own members. Several of them endowed professorships in natural history, chemistry and agriculture. For the most part their membership consisted of men primarily concerned with public affairs rather than dirt farmers.

The incorporation of the Berkshire (Mass.) Agricultural society in 1811 marked the beginning of a new trend. Its founder, Elkanah Watson, was convinced that the societies should be organized by counties and on a more democratic basis. His success in developing the fair as the main educational medium for agricultural societies led to an organizational movement that was practically nation-wide. The allotment of state funds to county societies was an important factor in their rapid expansion, begin-

ning with New Hampshire in 1817. With the discontinuance of state aid, the number of societies declined, but there was a revival of interest in them in the 1830s.

Following an abortive attempt to effect a national association in the early 1840s, the United States Agricultural society was organized in 1852 by representatives of 23 states and territories to co-ordinate the work of county as well as state groups. Its membership included farmers as well as men prominent in political life. It held annual sessions and sponsored exhibitions and field trials. It was influential in securing the establishment of the United States department of agriculture.

The nature of the problems confronting the farmers after the Civil War resulted in new types of societies. A series of farmer organizations turned to political action as a main means of improving the agricultural situation (*see* AGRICULTURAL ORGANIZATION). Simultaneously, with specialization in farming, societies began to be organized according to the crops or livestock raised. The oldest horticultural society was started in 1829, and several states authorized boards of horticulture relatively early. It was not, however, until after 1875 that the interest in pure-bred livestock resulted in the organization of numerous breed associations that maintained registries and otherwise promoted their respective breeds. Similar organizations appeared for the various field crops, vegetables, fruits and nuts. With the progress of agricultural education and the sciences pertaining to agriculture, the technical specialists formed the American Society of Agronomy, the American Farm Economic association and similar professional organizations.

With the 20th century, county societies as visualized by Watson disappeared or limited their activities to the annual fairs. Even the state societies lost most of their former influence. Their place in the field of education was taken by boys' and girls' clubs, the county farm bureaus and similar units of the Grange and the Farmers union, and by local clubs devoted to community development.

**Agricultural Fairs** and exhibitions were an integral part of U.S. rural life for more than a century and played an important part in the progress of agriculture. The first fair is usually credited to Washington, D.C., where a series of three was begun in 1804. Although combined with sales, premiums appear to have been offered. After a brief lapse, the Columbian Agricultural society held a series of five fairs in Georgetown, D.C., beginning in 1810. It remained, however, for Elkanah Watson, a wealthy business man who had retired to Pittsfield, Mass., for "rural felicity," to demonstrate and sell the values of fairs as a distinctive educational institution in the U.S. In 1807 he exhibited two Merino sheep on the village green, and three years later he induced his neighbours to form a society, pledged to hold an annual fair. Thus the Berkshire Agricultural society became the first permanent fair association in the United States.

The movement for county agricultural societies and fairs spread fairly rapidly, and Watson was active in assisting in their organization. In 1819 the New York legislature appropriated $20,000 for two years for the county fairs of that state, and after a few years other states generally provided modest subsidies for their fairs.

The fairs prior to 1870 were primitive and crude. Those held by county societies usually lasted two days and those by states three days. Few of the fairgrounds were more than 10 ac. in extent and usually not more than 1 or 2 ac. State fairs were rotated from city to city. Inadequate transportation was a drawback. For instance, low water on a navigable river often dictated failure. The inadequacy of funds was also a dominating factor. The premiums were modest, and the highest awards were usually certificates of membership in the society. Agricultural books and subscriptions to agricultural periodicals were also given as awards. In many lines the exhibits were meager and poorly classified, and the judging was done by impromptu committees. Plowing matches were held, but amusement features were subordinate. The annual address had a leading place in all programs. Horace Greeley was probably the most widely known and celebrated lecturer. Abraham Lincoln's address before the Wisconsin State fair at Milwaukee in 1859 may well have helped win him the presidency.

The Civil War had an unsettling effect on the fairs. The grounds were usually used as places for assembling and quartering troops and the Indian uprisings and invasions were disturbing. The years following 1870, however, brought revival and change. The country was experiencing a vast expansion of agricultural production Class-conscious farmer organizations sprang into being. The land-grant colleges became the established medium of agricultural education, and the work of the federal department of agriculture was extended.

In consequence, the main educational functions of the fairs came to be carried out in co-operation with the colleges and the farmers' institutes. The lectures and evening sessions were discontinued. The depressions and the competition of the world expositions cut the attendance. The amusement features came to the fore. Horse racing, velocipedestrianism, balloon ascensions and eventually auto races became major attractions. Circus stunts and spectacles such as locomotive collisions were added. Night shows featuring pyrotechnics were popular. Many of the fairs were extended to cover a week or more. The problem of what to emphasize on Sundays was solved by including sermons and musical concerts.

After 1910 there was a revival of interest in the educational features of the fairs. Boys' and girls' club work and farm bureau activities contributed immeasurably to this end. Judging contests, home economics, visual instruction, health clinics, agricultural engineering demonstrations and pageants received considerable attention. Many of the larger associations systematized their organization and hired expert managers. Including regional, state, district, county, community, township, school and street fairs, the number is around 3,000, and the range in character of exhibits, time and location is large.

The first great show of more than local importance, known as the American Fat-Stock show, was established in 1878 by the Illinois state board of agriculture and was held annually in Chicago from that time until 1897. It was the outgrowth of the desire of a number of stock breeders and feeders, as well as men interested in horses and swine, to stage a show in keeping with the progress of the purebred livestock industry. The show was patterned after the famous Smithfield Club show in England and flourished for many years until political influence and inadequate support caused its failure in 1897. Three years later, the present International Live Stock exposition was organized. It held its first show in Dec. 1900, at the Union Stock Yards in Chicago. It was founded largely through the efforts of a group of admirers of purebred animals which included such famous leaders as Robert B. Ogilvie, Mortimer Levering, William E. Skinner, Alvin H. Sanders, John Clay and John A. Spoor. Profiting by the experience of the old Fat-Stock show, the new organization laid plans for a great educational institution free from political favoritism. Following closely the ideals of the founders, succeeding directors have made the International the leading exponent of a great movement for the improvement of livestock and crops in the U.S. The International has been held annually in Chicago ever since its organization, except in 1914 and 1915, when it was omitted because of the presence of foot-and-mouth disease in the United States. Staged usually during the last week in November and the first few days in December, a time when all other fairs and shows have been completed, the International draws the year's prize-winning draft horses, beef cattle, swine, sheep, grain and hay exhibits from the United States and Canada. The organization owns its own grounds, covering 500 paved acres. Joined to the many barns and other buildings housing the show stock is the amphitheatre, seating 12,000 visitors and enclosing a tanbark arena 238 ft. long. There the finest livestock in North and South America are paraded before the eyes of leading judges of North and South America and Great Britain. Carlots of fat stock and individual dressed carcasses are exhibited. Standards have been set by this show. Year by year this institution has expanded until all major phases of U.S. agriculture are embraced within its scope. While the display of breeding and fat livestock is still the cornerstone of the exposition, many educational and

entertainment features have been added from time to time. The evening horse shows, including ponies, hunters and jumpers, saddle and light harness horses, have won world fame for the quality of the entries. The various state colleges have long been exhibitors of some of the finest livestock in all classes and the annual livestock judging contest for agricultural college students is of far-reaching importance as an educational feature. Within the last decade 1,000 or more farm boys and girls have attended the International annually as a reward for achievement in club work in agriculture and homemaking. Classes for baby beeves and lambs raised and fitted for show by these young farmers have formed one of the new and important attractions, and the livestock judging contest, open to champion junior judging teams from every state, is another innovation. Interest in feeding, fitting and showing livestock is encouraged by a large class of awards for herdsmen, caretakers and other helpers.

While the International is the livestock classic of the year, there are other shows of great importance to the regions in which they are held. The exhibits at such shows are often on a par with those at the International, although they draw from a much more limited territory. Such shows as the American Royal Live Stock show held annually at Kansas City, Mo., the Pacific International Live Stock exposition at Portland, Ore., the Southwest Exposition and Fat Stock show at Ft. Worth, Tex. and the National Western Stock show at Denver, Colo, are important shows held prior to the International. From these it draws many of the winning animals. The great show of the east is the Eastern States exposition held annually at Springfield, Mass., from its organization in 1916. Dairy cattle are the big feature of this show, although there are always excellent classes of all breeds of beef cattle, sheep, swine, light horses, hunters, jumpers and ponies.

The National Dairy show is primarily a show for the advancement of the dairy industry, although some classes are held for horses. Its livestock exhibit consists of 1,000 or more of the finest dairy cattle of all breeds in the U S. It is by no means limited to the livestock end of the industry. Machinery and equipment for the creamery, the distributing plant and every other phase of dairy manufacture, form a large part of the attraction and add to the educational value of the show. The show was first held in 1906 in the Chicago Coliseum. The success of this first venture resulted in the organization of the National Dairy association and the continued success of the show thereafter. It is a much travelled show, having been held in Chicago, Ill.; Columbus, O.; Springfield, Mass.; Milwaukee, Wis.; Detroit, Mich.; Indianapolis, Ind.; St. Paul, Minn.; and Memphis, Tenn. Another important dairy show is the Dairy Cattle congress held annually at Waterloo, Ia. The National Swine show is the leading show in the world of breeding swine and is devoted exclusively to this branch of the livestock industry. While in point of numbers it is often exceeded by some of the larger state fairs, no other swine show draws so many champions of the various breeds from all parts of the continent. It was organized by the National Swine Growers' association primarily as a breed-promotion institution, holding its first show in 1916 at Omaha, Neb. It has also travelled, having at different times been held in Cedar Rapids, Ia., and Des Moines, Ia. In 1921 it moved to Peoria, Ill., where the association now owns its buildings and grounds.

Poultry shows have been held in the United States for more than 50 years. Thousands of shows of varying sizes are held annually, small towns and communities having their local shows and many state fairs having poultry exhibits also. Large state shows are held later in the season and are followed by regional or international shows. The leading poultry show is the Madison Square Garden Poultry Show at New York city, where it has been a regular event from 1870. Thousands of birds are exhibited in individual cages designed to show them to advantage. Pigeons, bantams and every other variety and breed of feathered domestic fowl are included. The Boston show was the first large poultry show in the U.S., having been started in 1865. It is well balanced and in some respects is better than the Madison Square Garden show. Other poultry shows of nation-wide interest are held in various cities.

There is scarcely a branch of the agricultural industry that does not have some show of more or less national scope. Special shows are held by rabbit breeders and fanciers, by kennel clubs and by organizations interested in bees and in songbirds. There are shows exclusively for horses of certain breeds, for fruits and vegetables and for flowers. The Society of American Florists and Ornamental Horticulturists holds the National Flower show at a different place each year. The International Flower show is held annually in the Grand Central palace, New York city The American Orchid society holds a large show, usually every other year, at Madison Square Garden. Countless other flower societies exhibit their new products in various local and regional shows. Obviously all these exhibits are of immense value to specialists as well as amateur breeders and growers in making progress in their profession.

**Canada.**—Approximately 500 fairs are held annually in Canada, most of them being provincial or local Probably the first was at Niagara-on-the-Lake (then Newark, Ont ) in 1798 The most important is the Canadian National exhibition at Toronto. Held usually in September, it includes practically every branch of agriculture and allied industries and emphasizes educational features.

Another fair of note is the Royal Agricultural Winter fair, patterned after the Royal Agricultural society's show in England. It was first held in 1922 on the grounds of the Canadian National and grew rapidly. This annual show is usually in December and is limited to livestock, grain, hay and other farm products. Its entries are drawn from Canada, the United States and other countries.

Other agricultural fairs of note are the Central Canada exhibition at Ottawa, the Calgary Exhibition and Stampede, the Old Winter fair at Guelph, the Provincial exhibition at New Westminster, the Quebec Provincial exposition, the Provincial exhibition at Regina and the Great Eastern exhibition at Sherbrooke

**South America** holds many local or regional fairs and expositions every autumn, but the principal one is the Argentinian *Exposición Nacional de Ganadería,* usually called the Palermo show. This exposition ranks with the leading livestock shows of the world. It was inaugurated in 1875, with but 18 head of horned cattle by the Argentine Rural society (founded in 1866). Its early progress was irregular and in some years no shows were held because of financial and other difficulties. With the growth of the livestock industry in Argentina and other South American countries it finally became established and is now held annually in the autumn at Buenos Aires, where the society owns grounds and buildings near the fashionable Palermo suburb. The Palermo show is principally a beef-cattle show. There are often from 1,000 to 1,800 head of Shorthorn bulls in the show rings. The Shorthorn classification is perhaps the most elaborate show-ring exhibit to be found in any livestock show in the world, there being as many as 29 classes, in which the animals range from junior yearlings to 3-year-olds. The great number of classes is due to the separation of the animals into groups differing in age by from 15 to 30 days, whereas in other countries most show classes are from 4 to 8 months apart in age. Another unique feature is the compulsory auction of practically all animals exhibited, the purchaser paying a selling commission of 6%. The commission rate is doubled if the owner buys back his own exhibit. The auctioning of the grand champion bull is the outstanding attraction and has become an event in the social season. A week or ten days is often required to complete the auction after the closing of the show. Besides Shorthorns, other breeds are shown in great numbers and in good quality, as are horses of both light and draft breeds, sheep, swine, poultry and other agricultural exhibits. Dairy cattle are also an important feature of interest. The exhibition grounds are beautiful and in perfect condition and the buildings are elaborately designed and well-arranged around the show rings to permit all judging to be done in the open.

Two other important livestock shows in South America, both of which are held in Uruguay, are the National Live Stock and Poultry exposition at Montevideo, and the Live Stock and Poultry exposition at Salto.

The exposition at Montevideo is under the management of the Rural Society of Uruguay and is largely a cattle show, but there are usually good classes of sheep, swine, dairy cattle and horses. The Salto show is principally a cattle show, the Hereford breed predominating.

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(E. E. Es.; L. S. R.; X.)

**AGRICULTURAL STATISTICS.** Agricultural statistics have a vital, basic significance in a nation's social and economic welfare. The practical use of statistics of production, supplies and movements of the products of agriculture has been highly developed by business and governments. The world-wide depression of the early 1930s, and the ensuing increased activity of governments in aiding or controlling agricultural production and marketing added impetus to the further development and use of agricultural statistics War emphasizes still further the fundamental national importance of maintaining adequate sources of information on agricultural resources, potentialities and deficiencies.

The regular systematic collection of statistics relating to agriculture began early in the 19th century. Annual estimates of agricultural production were begun in France in 1815. In the United States, agricultural census taking began in 1840, and annual estimates of production in 1866.

In England it might be claimed that the first agricultural statistics were those collected in the 11th century in Domesday Book, which included a record of the use of all land then under cultivation. Gregory King estimated the use of land and the production of England at the end of the 17th century. But it was not until in the 19th century that the state undertook, as an ordinary function of administration, the annual collection of statistical information about agriculture. In the early part of the 19th century spasmodic attempts were made from time to time in different parts of the country to collect agricultural statistics. In 1855 a committee of the house of lords reported in favour of uniform and compulsory returns and in 1864 a resolution was passed by the house of commons demanding the immediate establishment of a national system of agricultural statistics. No legislation was passed but the board of trade gave effect to the wish of parliament and established a system of annual returns from every occupier of agricultural land of the acreage of crops and number of livestock on each holding. The returns were first obtained in 1866, and in 1884 they were supplemented by the collection of estimates of the year's yield of the principal crops. The responsibility for the collection of all agricultural statistics was transferred from the board of trade to the board of agriculture soon after its establishment in 1889.

The most systematic attempt to provide agricultural statistics by private enterprise was that made by Lawes and Gilbert in their calculations of the production and consumption of wheat in the British Isles. These were started in 1852 and continued annually until official estimates of the yield of wheat and other crops were begun 32 years later.

In many countries the field of agricultural statistics has been extended to include the collection of price data, estimating cost and income, and securing data relating to the occupiers of and the conditions of living on the land.

The International Statistical institute and the International Institute of Agriculture have been influential in extending the systematic collection of statistics relating to agriculture in many countries in recent years. About 1930 an effort was made to encourage countries which had not developed systematic census taking, to take a census which could be co-ordinated with the censuses of other countries so as to obtain a more complete world-wide coverage of agricultural production. The most significant development in agricultural statistics in recent years is the use of current and historical data relating to prices, supplies and economic conditions affecting the demand for agricultural products, to forecast or estimate probable prices in the market or the income from the products of the year. Such analyses are being used extensively in the U.S. and to some extent in other countries as a basis for formulating programs and policies relating to agriculture.

**Systems of Collection.**—Most of the larger nations, and many private business groups, maintain trained organizations and well developed methods for gathering agricultural statistics In the U.S., the department of agriculture issues comprehensive regular, periodic and special reports that are accepted by business generally as authoritative. The department's monthly forecasts and reports on crops and markets are awaited by all major lines of business and are quite a material factor in determining business activities. These statistical reports are gathered and compiled by a trained staff. In addition the department maintains specialized services throughout the country, such as those of grain inspectors at 135 shipping points and meat inspectors at packing centres The quinquennial census also provides comprehensive data and serves as a valuable test-check.

There are a number of private agencies that supply agricultural statistics which are accepted as authoritative These usually relate each to a specific commodity such as cotton, wheat, sugar, etc Outstanding among such statistical organizations is Broomhall's, Liverpool, whose forecasts and reports on grain are standard market information throughout the world. The New York Cotton Exchange, and other large commodity markets maintain permanent statistical organizations to supply information on production and distribution.

**Statistics of World Agriculture.**—Nearly all countries have been signatories to the International Institute of Agriculture, Rome, which supplies regular monthly and annual reports and special studies on the major crops, livestock and livestock products of the entire world, excepting chiefly U.S.S.R. and China, for which information is fragmentary. The Institute issues a monthly *International Review of Agriculture*, which contains official reports on conditions of agricultural production in nearly all countries, forecasts of crop yields and size of harvests. The Institute's *Yearbook of Agricultural Statistics* is an annual summary of world agricultural production and, like its monthly reports, is printed in English and French.

The average annual production (1935–39) of four principal cereal crops in major producing areas was as follows, the figures representing millions of bushels.—

| | Wheat | Rye | Barley | Oats |
|---|---|---|---|---|
| [illegible] (Except U.S.S.R.) | 1,626 | 898 | 719 | 1,745 |
| [illegible] | 1,086 | 54 | 331 | 1,384 |
| [illegible] | 143 | 1* | 121 | 22 |
| Asia (Except U.S.S.R.) | 1,442 | | 768 | |
| [illegible] | 281 | 10† | 28 | 61‡ |
| Oceania | 177 | 0.2 | 13 | 27 |

*University of South Africa only
†Argentina only
‡Argentina, Chile and Uruguay only

Statistics of farm livestock are less complete than those of crops and are in many countries collected infrequently at irregular intervals. The following table shows approximately the world's totals of the principal meat animals in comparison with the human populations of the six great world areas, in thousands.

| | Population* | Cattle† | Sheep† | Hogs† |
|---|---|---|---|---|
| Europe (Except U.S.S.R.) | 398,287 | 110,200 | 129,200 | 81,200 |
| [illegible] | 170,467 | 48,500 | 70,080 | 23,900 |
| [illegible] | 182,409 | 96,000 | 59,700 | 61,300 |
| [illegible] | 91,192 | 105,600 | 101,000 | 31,200 |
| U.S.S.R. (Europe and Asia) | 1,108,634 | 283,000 | 130,500 | 80,900 |
| Africa | 158,408 | 61,100 | 100,600 | 3,300 |
| Oceania | 10,610 | 18,000 | 143,900 | 2,100 |

*International Institute of Agriculture, 1938 figures
†Reports of U.S. Department of Agriculture, Office of Foreign Agricultural Relations, averages for 1936–40

Unfortunately no statistics of any reliability are available for China (pre-eminently an agricultural country). The annual value of pigs reared in China must be enormous and cattle and horses are everywhere in evidence; but the unsettled state of the country has made records difficult to obtain.

The distribution of the animals and their relative importance as indicated by their density are shown in the following table.—

| Country | Number of livestock per 1,000 hectares* | | | |
|---|---|---|---|---|
| | Horses | Cattle | Sheep | Pigs |
| United States | 14 0 | 85 8 | 68 4 | 57 4 |
| United Kingdom | 45 6 | 363 6 | 1,091 3 | 181 7 |
| Canada | 3 1 | 9 5 | 3 8 | 3 9 |
| Germany† | 73 0 | 435 6 | 99 7 | 506 6 |
| France | 48 9 | 286 8 | 181 4 | 129 2 |
| Italy | 25 5 | 247 3 | 305 3 | 94 8 |

*1 hectare=2 47 [illegible] do not include Austria or the Sudeten; do include Saar. [illegible] 1938

**Statistics of British Agriculture.**—For many years statistics of British agriculture were collected by the Board of Agriculture for Great Britain and the Department of Agriculture for Ireland. In 1912 the Board of Agriculture for Scotland was established and took over the collection of statistics in that country. When Ireland was divided, separate departments were set up for Northern Ireland and Eire so that there were then four departments responsible for the agricultural statistics of the British Isles.

During World War II food production was greatly expanded as indicated by the following figures of acreage and production:

| Crop | Acres (thousands) | | Production (million bu.) | |
|---|---|---|---|---|
| | 1939 | 1944 | 1939 | 1944 |
| Wheat | 1,766 | 3,220 | 61 4 | 117.2 |
| Barley | 1,013 | 1,973 | 41.6 | 81 8 |
| Oats | 2,427 | 3,656 | 140 2 | 206.7 |
| Potatoes | 704 | 1,421 | 194 7 | 368.1 |

The numbers of farm livestock, including poultry, in the United Kingdom in 1944 were as follows: Horses and colts, 918,000; cattle and calves, 9,501,000; sheep and lambs, 20,108,000; pigs, 1,867,000; chickens, 50,301,000; ducks, 3,004,000; geese, 905,000; turkeys, 995,000.

Particulars of other crops, and statistics relating to agricultural output which are not included in the annual returns are obtained from time to time in connection with the census of production (*see* AGRICULTURE, CENSUS OF).

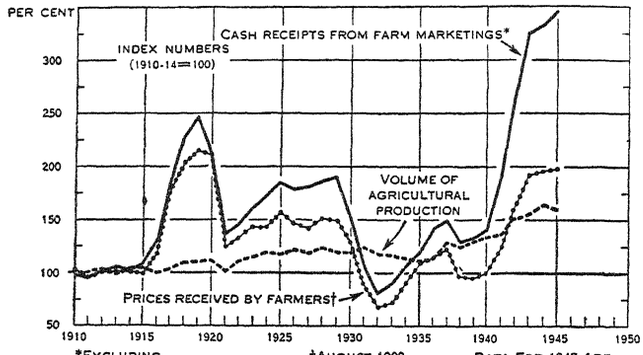
**Statistics of Agriculture in the U.S.**—The averages (1934–43) of the annual estimates of the area and production of some of the principal crops in the U.S. are presented as follows:

| | Acres harvested (millions) | Production (million bu.) |
|---|---|---|
| Wheat | 53.8 | 789 1 bu |
| Corn | 91 2 | 2,433 1 bu. |
| Barley | 12 0 | 273 5 bu. |
| Oats | 35 8 | 1,068 4 bu. |
| Cotton | 25 6 | 12.3 bales |
| Tobacco | 1.5 | 1,392 0 lbs. |
| Potatoes | 3 0 | 375.1 bu |

The crop areas seeded and harvested in the United States vary considerably from year to year. The area of wheat harvested is in many years considerably less than the area seeded because of heavy winter freezes, droughts and diseases. The acreage losses from the seedings of the other crops are as a rule small. The estimates given above represent the areas harvested. The 10-year averages are presented as a better indication of areas and yields than the estimates of any one year which may be affected significantly by droughts or other conditions causing considerable changes in either the area harvested or the outturn of the crop.

In recent years the department of agriculture has extended its estimating service to include intentions to plant crops. The data are collected in advance of seeding so that each individual farmer may have some information as to what farmers generally are planning to do for the forthcoming season. These data are useful in determining the marketing policies of both private and co-operative distributors. They are used by the federal government also in determining production and marketing policies. Averages of the annual estimates for the 10 years (1935–44) of the numbers of the most important species of livestock on farms in the U.S. are: horses and mules, 14,729,000; dairy cattle, 25,656,000; all other cattle, 45,381,000, sheep, 52,768,000; hogs, 55,300,000, chickens, 447,889,000

The numbers of animals in the U.S. vary considerably from year to year and in cycles of years. The production of hogs in the U.S. is such an important factor in the agricultural economy of the country that an elaborate statistical service has been developed for this industry. In addition to estimating the number on farms as of January 1, the department of agriculture estimates in June and December of each year the number of pigs farrowed and the number of sows bred or to be bred. These estimates of breeding and farrowing are designed to provide a basis for estimating the number of hogs likely to be marketed and the pork production in the season ahead. Reports from slaughter establishments provide a basis for estimating the actual production of pork. The dairy and beef-producing industries of the U.S. are likewise important, but the changes in the numbers of cattle on farms are less variable from year to year and have longer production cycles which can be anticipated to a considerable extent from supplies of feedstuffs and the relation between prices of feedstuffs and of the animal products.




COURTESY, U.S. DEPT. OF AGRICULTURE

**AGRICULTURAL PRODUCTION, PRICES AND RECEIPTS, UNITED STATES, 1910-45**

Estimates of income have been developed as measures of the buying power of farmers, as indications of how economic conditions generally affect farmers. Also, the relative importance of the several agricultural enterprises of the country is best indicated by the estimates of income received from these enterprises.

The average income received from principal farm products in the five years (1940–44) follows, in millions of dollars:—dairy products, 2,305; cattle and calves, 2,116; cotton, 1,147; hogs, 2,013; chickens and eggs, 1,509; wheat, 765; tobacco, 459; sheep, lambs and wool, 414; corn (maize), 479; potatoes, 159.

The importance of corn (or maize) and other feedstuffs is, of course, not indicated by estimates of income received directly from those crops. The production of such crops comes to market mostly as livestock products. Consequently, the variations in prices of feedstuffs have little significance in the income of the country. They are an indication of the relation of supplies of feedstuffs to the demand for them and affect costs of production as between the farmer who raises the feedstuffs to sell and the farmer who buys them for feeding.

The effects of recovery and of World War II on the agricultural economy are reflected in the annual estimates of cash income from marketings of farm products. Annual estimates[1] for the years 1932–44 follow, in millions of dollars: 1932, 4,743; 1933, 5,314; 1934, 6,334; 1935, 7,086; 1936, 8,367; 1937, 8,850; 1938, 7,686; 1939, 7,877; 1940, 8,343; 1941, 11,157; 1942, 15,316; 1943, 19,340; 1944, 20,228.

The receipts from the sale of farm products are estimated currently for each month, on the basis of prices reported as received by farmers and estimates of marketings by states as well as for

[1]These estimates do not include government payments, nor the value of products consumed on the farm where produced

the country as a whole. The expenditures for production annually are also estimated to provide a basis for determining annual net returns. (E. J. WG.; O. C. S.; R. H. R.)

**AGRICULTURAL WAGES.** The payment of wages for agricultural labour in England began with the disappearance of serfdom. The coming of the Black Death or plague in the middle of the 14th century hastened the growth of the wage system and stimulated a rise in wages. The Statute of Labourers was enacted in part to check this rise. The change to the wage system came much later in eastern Europe. Even today most of the wages are paid in kind in some regions. The money wage system was carried into all of the English colonies, in many places in combination with a system of indentured servants and with slavery. When slavery was abolished in the United States, a wage system would seem logically to have followed. The Negroes, however, were not yet ready for this step and presently most of them were working under a cropper system in which they lived on plantations in cottages furnished by the owner, used equipment furnished by the owner, and received their compensation in the form of a share of the crop. Those familiar with this system still look upon it as more nearly a wage relationship than a landlord-tenant relationship.

A major complication in measuring wage-rate changes is that in all countries a good part of the actual compensation of the farm worker is in the form of board and lodging, in the case of single men, and of food and fuel for the use of the family and the use of a dwelling, in the case of married workers, plus perhaps the right to use a plot of land or to keep some livestock on the employer's land. In central Europe these allowances are known by the term deputat; in the United States as perquisites. Where wages are regulated, official valuations may be placed upon these extras; otherwise the wage-reporting agency must make a rough estimate of their value. The basis of valuation is invariably what these allowances are worth in the immediate neighbourhood. Commonly they would cost very much more if they were being purchased by an industrial worker in the city. The listing of wages is also involved by the fact that the period of hiring may be the whole year, the summer or winter half-year, a few months during the spring and early summer, or from day to day. The day labourers may be casuals hired for a few days now and then or workers hired regularly by the day for a considerable period. The most numerous in the first group are the piece-rate workers, who help especially with harvesting. The year-round rates reported are commonly for more experienced workers carrying more responsibility. Many of them are part-managers of the farm enterprise, perhaps in some such capacity as herdsman or shepherd. The farm servant in Great Britain and several other countries, and the deputatist of Germany and other countries on the continent, are typically year-round workers on a somewhat lower wage scale. From the point of view of income, only the data for the year-round workers are adequate. One has no means of knowing how much of the rest of the year the seasonal workers and day hands are without employment.

**History of Wages.**—Money wages need to be converted to real wages before they are significant. This can be done crudely for the United States since farm wages were first assembled in 1866 by adjusting them for the changes in the general price level. The money wages increased 20% from 1869 to 1897, and the real wages 135%. Then came the period of rising price levels ending in 1915, during which money wages rose 58% and real wages only 10%. The final effect of World War I was a rise of 85% in real wages by 1925–29. Real wages in industry rose 150% to 1897, held even until 1915, and then rose 63% to 1925–29. The lag in both agricultural wages and industrial wages in 1897–1915 was due mainly to the inability of wages to move as fast as prices. Wages in wartime Europe lagged in the same way. The wartime shortages of labour broke this lag. Farm wages did not rise as much as industrial wages in the recovery period after 1933.

For a longer series of wage changes, England can be taken as an example, but real wages for such series will have to be expressed still more crudely in terms of wheat. In terms of money, agricultural wages in England rose from 4*s.* per week in the 13th century to 46*s.* by 1775, but in terms of wheat this represented an actual decline from 126*£* to 71*£*. This is the reason for Thorold Roger's statement in his *Six Centuries of Work and Wages* that the 15th century was "the golden age of the English labourer." By the end of the 19th century the purchasing power of wages for wheat had returned only to the 15th century level. All through the 16th to the early 19th century, weekly wages in wheat remained around 71*£* to 91*£*. The movement from then until World War I was roughly the same as in the United States. In 1914, a week's farm work in Great Britain bought 4.2 bu. of wheat. Money wages had advanced 24% from 1900 to 1914, but real wages 15%. Wages rose less than the cost of living during the war, and the Agricultural Wages' board in 1920 set wages at levels from 42*s.* to 56*s.* in the various counties. The passage of the Repeal Act of 1921, following the sharp break in prices, wiped out this board, and the wages and voluntary conciliation committees set up in its plan were not very effective. Wages fell to 28*s.* by 1924, compared with 18*s.* in 1914. This meant a decline of 12% in real wages. The new boards set up under the Agricultural Wages Act of 1924 had raised wages 3½*s.* by 1931 while the cost of living was declining. Real wages as a result rose one-fifth in this period.

For the years after 1928, much more adequate data were assembled by the International Labour office, and published first, for 27 countries, in the *International Labour Review* for Nov. and Dec. 1934. The latest release, in the *Yearbook of Labour Statistics, 1945–46,* extends this series through 1937 for 21 countries, through 1942 for 17, through 1945 for 12 and into 1946 for 7. Money wages declined in all these countries except Chile in the big depression of 1930–35, but by varying amounts. The lowest year was 1933 in the aggregate, but ranged from 1931 in Japan to 1937 in India. In five countries, including the United States and Canada, the break was around one-half; in Australia, New Zealand, Japan, India and Italy, around 30%; and in the western European countries, between 4% and 11%. All but three in this last group either had agricultural wage boards or were supporting farm prices with heavy import duties and the like.

In the period leading up to World War II, farm wages generally rose. The gains were smallest, around a fifth or less, in the exporting countries, like the United States, Canada and Australia, and most in the countries of western and central Europe, from 30% to 50%. The severity of the continuing unemployment to 1935 was no doubt also a factor, and presently in Europe, the amount of preparation for war. If depression losses and recovery gains are balanced against each other, farm wages in Canada and the United States in 1940 were around 30% below the 1929 levels; in Australia and Mexico, 10% below; in Great Britain, 6% higher; and in Norway, France, Ireland, Sweden and Denmark, from 10% to 40% higher respectively in the order named.

No doubt the extent of the general price deflation in the depression, and reflation afterward, was also an important factor in these wage movements. Clearly the general price level movements were the main reason for the difference between countries in the wage increases during World War II. In the International Labour office tables, the index numbers for 1945 range, with 1937=100, from 138 in New Zealand, 159 in Australia, 203 in Sweden and 210 in Great Britain, where prices and wages were kept fairly well under control, to around 250 for the United States and Canada, to around 300 for Denmark and Norway, and 500 for France and Finland.

**Wage Differences.**—Wage differences between countries are best indicated by taking the data on money wages of the International Labour office for some nearly normal year, like 1928, and reducing them to a common purchasing power basis, as in the table on page 391I.

The wage taken as representative in each case is the wage without board and lodging of an adult male ordinary day labourer. The conversion to shillings and pence is in terms of the average rate of exchange for the year 1928. The prices for wheat and other products are the internal wholesale prices at a principal market in the country.

Taken at their face value, the differences appearing are very

| Country | Daily wages | Wages in British money | Wages in wheat (bu.) |
|---|---|---|---|
| China | 0.19 silver dollars | 4*d* | * |
| Japan† | 0.86 yen | 1/10 | 0.13 |
| Rumania‡ | 36 leis | 1/3 | 0.24 |
| [illegible] | 13.2 koruny | 1/7 | 0.23 |
| [illegible] | 6.1 litas | 2/6 | * |
| Spain | 4 pesetos | 2/9 | * |
| Chile¶ | 5.50 pesos | 2/9 | * |
| Poland | 6.2 zlotys | 2/10 | 0.43 |
| Hungary§ | 1.37 pengos | 3/1 | 0.51 |
| Italy | 15.9 lire | 3/5 | 0.45 |
| Finland | 33.84 marks | 3/6 | * |
| Germany | 4.10 marks | 4/– | 0.63 |
| Sweden | 4.24 kroner | 4/8 | 0.88 |
| Denmark | 4.58 kroner | 5/– | 0.93 |
| France | 32.4 francs | 5/2½ | 0.75 |
| Great Britain | 5/3½ | 5/3½ | 1.00 |
| Norway | 5.01 kroner | 5/6 | * |
| Switzerland** | 8.2 Swiss francs | 6/6½ | 0.71 |
| [illegible] | 2.39 dollars | 9/10 | 1.89 |
| [illegible] | 11/0 | 11/6 | * |
| [illegible] | 3.15 dollars | 13/– | 2.30 |
| [illegible] | 16/– | 16/– | 3.14 |

*No wheat prices available. †All figures are for 1931. ‡All figures are for 1932. ¶All figures are for 1929. §Figures for money wages are 1928, for wheat wages, 1932. **All figures are for 1930.

large: from 4 pence in China to 16 shillings in Australia. They are in order with what we know about relative density of population and other significant factors in the various countries; but the range is no doubt exaggerated in terms of real wages. The number of yen equal to a shilling in the foreign exchange market buys much more in the way of food, clothing and shelter in Japan than the number of kroner equivalent to a shilling in Sweden, and even more so than the number of cents equivalent to a shilling in the U.S. market. The comparison in terms of quantities of wheat bought by a day's wage is subject to the serious objection that the price of even as staple a commodity as wheat is subject to special influences in each country; for example, to very high tariffs in France, Italy and Switzerland. Wheat prices in Canada, Australia and the United States are on an export basis, which means that they are less than the world price by the amount of the cost of transportation.

The International Labour office reports male and female wages separately where available; also wages of "permanent," "seasonal," and "daily" workers. Female wages in 1928 averaged about 70% of male workers. Wages of seasonal and day workers are generally higher than annual rates. In the United States, for example, a day labourer would have needed to work only 240 days in 1928 to earn as much as a year-round labourer without board and lodging; in Japan, 200 days.

The wage differences between sections of any one country may be fully as large as those between whole countries. The range within France in 1928 was from 16 francs per day for regular day labourers in Dordogne to 27 francs per day in Loiret; in Italy, from 0.66 lire in Calabria to 1.59 lire in Emilia. The total wages of the deputatists (men) in 1928 were 1,619 zlotys in south Poland and 2,263 in west Poland. In the United States the range in the period 1925–29 was from around $25 per month in the southern states (with board and lodging) to more than $50 a month in some of the western states. These differences in the U.S. are closely correlated with such factors as natural resources and capital goods per worker, and in turn with the net farm income per worker. Associated with these circumstances are such factors as density of population, type of agriculture, alternative employment and the like. The high wage rates reported in some of the eastern states are much affected by competition with city employments. Almost everywhere the level of agricultural wages appears to be lower than that of industrial workers, particularly than that of skilled industrial workers. The explanation commonly offered is that the surplus population of the farms does not move to the cities rapidly enough to equalize returns.

**Wage Regulation.**—Wages were controlled in one way or another in England all the way from the Black Plague until 1835. The controls were largely locally administered and generally in behalf of the landed gentry, and had the effect of shifting to Poor Law relief part of the cost of maintaining farm labour. Similar controls commonly followed the abolition of serfdom on the continent. Individual bargaining replaced these controls with the passing of mercantilism in one country after another in the 19th century. Controls in behalf of farm labour began in the early 20th century; for example, in England in 1917. In North America, the new Mexican constitution in 1917 provided that minimum wage rates should be fixed for all the workers. Estonia provided for fixing minimum wage rates in an act of 1921, and Hungary, Uruguay and Argentina in acts of 1923. The present form of public wage fixing in England was provided in the Agricultural Wages Act of 1924. It can be said of the wage-fixing legislation enacted in the war and postwar years that its general purpose was to raise agricultural wages and improve the condition of agricultural workers. But much of it was induced by pressure from agricultural unions. An immediate purpose was to remove the causes of disorder and conflict between the employer and worker groups. It is proper to state that in a number of the countries agricultural wages are now adjusted mainly by collective bargaining. A large proportion of the labour may be outside the union, but the union dominates the scene.

In the Netherlands, for example, collective agreements increased from 11 covering 742 farms in 1918, to 326 covering 20,700 farms in 1936. By 1937 the wage rates of 30.000 Swedish workers were covered by trade union agreements. Collective bargaining is the device used for general wage adjustments also in Denmark, France and Norway. This system was well developed in Germany in the postwar years under the republic and in Czechoslovakia and Poland before 1938.

In Scotland the Farm Servants union insisted upon this method of wage adjustment until July 1937. It then secured the adoption of a plan of public wage fixing similar to that prevailing in England and Wales. As a matter of fact, wage determination by collective bargaining and by public wage fixing are not as clearly distinct as the foregoing statements indicate. The two methods are frequently made to supplement each other. Thus in Italy the wages are negotiated by collective agreements, but the Charter of Labour requires that the wages so determined apply to all workers whether organized or not. In the Netherlands the employers are required to negotiate wages with the workers' organizations and if necessary an arbitrator makes a compulsory award. In Australia and New Zealand the process of public wage fixing takes the form of calling the workers' organization and the employers' organization before an arbitration court, holding a hearing, and then establishing a rate. Even the procedure of England and Wales, which is clearly designed as minimum wage fixing, sets up local wage-fixing boards upon which the workers' organization and the employers' organization constitute all the board except for a small number of outside members appointed by the minister of agriculture.

The Central Agricultural Wages board has no power to influence the level of wages fixed by the local wage boards. The Irish Agricultural Wages Act of 1936, in contrast, gives to the Central Wages board the authority to fix the minimum wage rates, but only after consultation with the local wage committees upon which employers are represented. The Joint Labour committees set up in France on a regional, department and local basis under the order of July 7, 1946, were constituted about like those in England and function in a similar way. The wage boards which functioned in parts of the United States in World War II had little or no union or even employee representation on them, farm labour being very little organized in the United States.

The reason commonly advanced for having employer and employee organizations participate in the wage-making process is that the wages fixed are not likely to be accepted unless these groups help make them. The objection, of course, is that the unorganized employers and employees are required to abide by wage determinations made by organized groups that often are only a small minority. If, however, it is the policy of the country to encourage the unionization of agricultural labour, such an arrangement may well have the effect of bringing most of the employers and workers into it.

Hours and working conditions are commonly regulated along with wages. In England the hours set by the different county boards ranged in 1937 from 48 to 60 per week, with an average of 51 hours. Regulations also provide for extra pay for overtime

and Sunday labour, but these are not always enforced. The Holidays with Pay Act of 1938 provided for 7 days of holiday for farm labour, but not more than 3 days at a time. The New Zealand Agricultural Workers Act of 1936 incorporated in it the Accommodation Act of 1908 which stipulated certain standards of first aid, housing, laundry and food storage space for agricultural workers. Illustrating the form that wage regulation may take when modern forms of regulation are imposed upon relic social organizations are the decrees issued by the Bolivian government in May 1945 providing for setting up an Indigenous Labour Code limiting to 4 days the labour that can be required of the "colones" on the landowner's estate as payment of rent, and giving the colones full right to sell their own produce

A development since 1930 in several countries is that minimum wage rates have been tied to arrangements for improving the prices of farm products The sugar growers of the United States must pay certain rates to share in the benefits of the Agricultural Adjustment act The New Zealand butter and cheese act of 1937 has a similar stipulation. Swedish sugar factories may conclude contracts only with farmers who agree to pay the wages named in the collective agreements in force

BIBLIOGRAPHY.—W. H Pedley, *Labour on the Land* (London, 1943), John D. Black *et al, Farm Management* (1947); Harry Schwartz, *Seasonal Farm Labor in the United States* (1945). (J D. BL)

**AGRICULTURE: A GENERAL SURVEY.** Agriculture is so primitive and fundamental an art, the beginnings of which so far precede any documents, that any attempt to write its earliest history becomes a matter of surmise and unverifiable conclusions from general principles It is reasonable to suppose that prehistoric hunter man began by learning to tame the young of certain species, which proved to be fertile in captivity and could be attached to his wanderings. At probably a later stage tribes that gathered certain grains of food value began to make provision for future years by scattering a portion of the seed and effecting some rough clearance of the soil. They took the desirable grains with them in their wanderings and by sowing them they learned to become independent of return to the original centres of growth. When any remains of the early settlements emerge, they reveal evidence of animals and cultivated plants For example, predynastic tombs in Egypt, an early Sumerian house in Mesopotamia (3500 B.C.), and lake dwellings in Switzerland and Italy associated with neolithic man, have yielded grains of wheat of a comparatively advanced type, which must have been preceded by long ages of culture. Flax and barley were also grown. It is significant, however, that no wild species can be assigned as the origin of any of our widely cultivated plants and the same complexity and uncertainty gathers round the sources of the domesticated horses, sheep, oxen and pigs. With the exception of maize and barley, the cultivated plants are polyploids, *i.e.*, the number of chromosomes in the cells is a multiple of the diploid number which characterizes the normal species. This points to a probable hybrid source; but whatever the origin, the polyploidy provides material susceptible of the variation on which selection can work, even when it is not attended by giantism or an excess of vigour which would naturally draw the attention of the early cultivator. Though no wild species can be fixed upon as a starting point of our cereals, N. I Vavilov argued that the existing distribution of varieties points to certain centres as the original fountain of the cultivated races these being regions which are today characterized by a concentration of varieties in the cultivated fields, where a host of forms occur not yet segregated into distinct races and shade off into weed forms which equally inhabit the uncultivated land Vavilov thus indicated the highlands of southwestern Asia, particularly Afghanistan, as the probable centre of the soft and club wheats, northern Africa as the home of durum wheats, while einkorn, a primitive wheat cultivated in prehistoric times, may have had its origin in Asia Minor. Still another race, emmer, perhaps the most ancient of cereals, is found in patches all over the old world and only among isolated and backward peoples (*See* also AGRICULTURE PRIMITIVE)

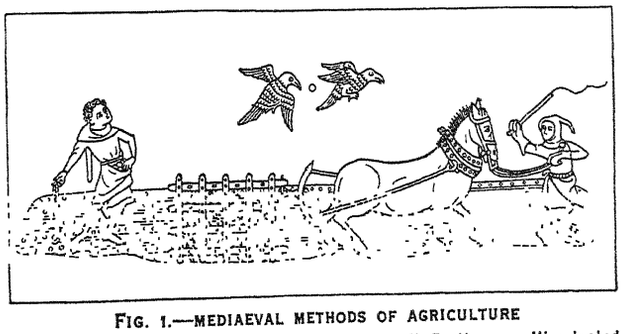


FIG. 1.—MEDIAEVAL METHODS OF AGRICULTURE

Scaring birds and harrowing. From the Loutereil Psalter, an illuminated manuscript of the early part of the 14th century. ("Vetusta Monumenta," vol. 6, Pl. XXII, fig. 7)

Similar general conclusions cannot be drawn concerning the early history of the growth of husbandry When agriculture appears in written history in the time of the Greeks and Romans (*see* GEOPONICI), it is already a highly developed art, which had behind it many centuries of empiric progress, the results of observation and of trial and error Cato, Varro, Virgil, Columella and the elder Pliny described an elaborate system of farming, embodying many sound principles, such as the value of leguminous crops as a preparation for wheat, for which modern science only lately found an explanation The methods of growing corn, vines and olives then prevailing were not substantially altered until the middle of the 19th century, and the sculptured representation of a sacrificial bull, lamb and boar on the *plutei* of Trajan in the Roman forum bears witness to an advanced state of stock breeding. Roman agriculture is indeed the foundation of modern farming, and though over a greater part of Europe it was disrupted by the barbarian invasions, its traditions probably never died out in favoured regions but were resumed in modern systems of farming

**Mediaeval Farming.**—The course of farming in England that prevailed in early days is in many respects common to all the invading northern peoples who drifted across Europe; it finds its parallels in all countries north of the Alps, in Russia and in India It is not uniform, since on the western side of Wales and Ireland, there is evidence of an earlier system, which is reflected in the grouping of the houses into scattered hamlets instead of into the larger villages characteristic of the more purely arable districts of the Midlands and eastern England. Whether the system was derived from an original communal ownership of the land and even of its produce is still a matter of dispute, but when records begin it had passed out of this stage and to some extent had been shaped by feudal theory (*see* ENGLISH HISTORY).

**The Manor.**—The unit of land holding and cultivation was the manor (*q v.*), of which there might be one or more within the parish. The land was held at one or more removes from the king by the lord of the manor, from whom the tenants held in return for various services and with varying degrees of freedom. The cultivated land lay in three, or some multiple of three, open arable fields, divided into strips of one or one-half acre, separated by baulks of rough grass and terminating in still wider baulks, the headlands on which the cumbrous ox team and plow could turn. On heavy land the strips were steeply ridged to throw off the water and this ridge and furrow still persist in many parts of the Midlands which have long been laid down to grass. In some places the old strips still defy cultivation, because of the labour that would be required to throw down the ridges and the infertility of the subsoil that would be bared in their crowns.

The three fields were cropped on a fixed rotation of winter grain (wheat or rye), spring grain (barley, oats, peas or beans, or mixed corn) and bare fallow. In each field the tenants held a certain number of scattered strips, the original intention being probably to give to every man a share of the good land and the bad, and mingled with them were the strips held by the lord and constituting his demesne. Each tenant farmed his own strips but was required to give a stated number of days' service to cultivate the demesne strips, services which gradually became commuted into payments in money or in kind. At a certain date after harvest the arable land was thrown open to the cattle to

wander over, and this of itself prevented any growth of fodder crops. On the lower land by the river would exist an area of meadow land to be laid up for hay and again divided in proportion with the arable land. The tenure of the particular strips for the year was often balloted for, a practice which still endures in places, as at Yarnton near Oxford. After hay harvest or Lammas the meadows were thrown open for common pasturage, hence the name "Lammas fields." Besides the arable and the meadows the manor embraced a certain amount of "waste," the origin of what today are known as "commons" (*q.v.*). On these the tenants had the right of pasturage and in suitable districts the right to cut turf or peat for fuel. They also provided fern for litter, reeds or heather for thatching, furze and brushwood for firing, rushes for the floors and other purposes, rough timber for fencing and building, stone, gravel and sand.

**Production.**—The farming that prevailed under these conditions was necessarily inefficient. Some manure appears to have been made by strewing roughage, marl or clay in the folds and in the "garsons," the little enclosures by the village into which the stock were driven at night; but the crops must have mainly depended upon the inherent fertility of the soil. The sheep were folded upon the fallow by night, though tenants were often obliged to put them upon the lord's land only. In the west where the area of unoccupied land was greater, there is evidence of a practice of moving the arable fields continually, whereby some fertility would be accumulated while the land lay in rough pasture Of extraneous fertilizers there were none; in areas on the chalk the practice of sinking pits into the chalk and spreading it on the land may have endured, for it is mentioned by Pliny in his account of Britain, and the traces of the old pits that remain in certain districts indicate a long continuance of the process of chalking and marling. The level of production was exceedingly low. Walter of Henley, who wrote early in the 13th century the standard treatise on the management of an estate, advised the sowing of two bushels of wheat per acre, which ought to yield threefold. From the context this would be a minimum, and the same author said that barley might yield eightfold, wheat fivefold, rye sevenfold, peas and beans sixfold and oats fourfold. Other sources justify placing the level of production of open field land in mediaeval times at yield of about ten bushels of wheat to the acre.



FIG. 2.—MEDIAEVAL HUSBANDRY Feeding chickens. From the Louterell Psalter, an illuminated ms. of the early 14th century. ("Vetusta Monumenta")

If the conditions of cropping were bad, the livestock were in a worse state. The stock of all the tenants and of the lord herded together and were driven afield and tended by the village cowherd, shepherd and swineherd respectively. The class of stock that prevailed depended to some extent upon the nature of the land. The open downs and heaths had many sheep, and the woodlands with their mast supplied feed for swine.

Pannage (*q.v.*) for so many hogs is a common entry in Domesday as an appanage of a particular holding. But with this mixture of everybody's stock little in the nature of selective breeding could be practised. Walter of Henley insisted on the value of good boars, but in general the bull and the boar were common to the manor—the result was a "haphazard union of nobody's son with everybody's daughter." Whatever disease came along ran riot through the whole herd or flock. Oxen were chiefly kept for work, and Walter of Henley considered an ox at work should consume half a sheaf of oats a day. Though the greater speed of the horse was recognized, it required more care, cost more to feed and was "carrion" instead of meat when worn out. Cows were kept for milk and the milk was mainly converted into butter and cheese. In the early summer they grazed on the "waste" and marshes or were tethered on the grass baulks; later they had the aftermath of the meadows and the stubbles. With the advent of winter the worn-out oxen and the old cows were killed off and salted down. During winter the cattle subsisted in the yards on hay, pea and bean haulm and straw. Rarely were cattle stall-fattened and the open field farmers sold most of their calves for slaughter. Sheep were from the earliest times an important element in English farming because of the value of their wool. The ewes were often milked, the toothless "crones" being killed for meat.

During the open weather they lived on the downs or the waste by day and were folded on the fallow by night; in the depth of winter they were housed or folded and fed upon whatever roughage was available. Swine afforded the chief meat of the community; they scavenged for a living in spring or summer and fattened upon the pannage of the woods. A few were specially fattened upon tail corn and the brewers' grains, for the barley that was grown was very largely turned into ale. The manor aimed at being self-supporting both for food and clothing. Rarely had even the lord any margin of corn for sale; the chief money revenue was derived from the livestock, wool, skins and dairy produce.

**Enclosures.**—The strict manorial system early began to break down. The lords often retained meadows and made enclosed fields which they either farmed themselves or let. Little holdings grew up by sufferance on the waste, occupied by "tradesmen" in the villages or other cottagers who also shared in the common grazing The rising value of wool in the late mediaeval times tempted lords to aim at enclosures of the arable, and recurring dearths and epidemics, of which the Black Death is the most notable, deprived the land of its labourers and facilitated the putting together of larger units of cultivation. From the earliest times the substantial independent farmer, represented by Chaucer's Franklyn, was a feature of English country life. Not only were the old feudal services commuted into rents, but by new intakes from the wastes or by fencing off portions of the open fields the tenants began to enjoy land in severalty. In Tudor times the process of enclosure was in full swing, though the legislature was opposed to, and public opinion was loud in denunciation of, a movement which appeared to diminish corn growing and the rural population. But the driving force was the growing commerce of the nation. Not only did both landlords and tenants want something to sell and look upon the land as the basis of a business rather than a subsistence, but the small holders who had been barely able to exist upon their little parcels of cultivation found other and more attractive outlets in the growing commerce and industries.

**The New Farming.**—It was toward the close of the Tudor times and in the early 17th century that the new farming began. Increasing intercourse with the continent and particularly with Flanders, where some of the old Roman tradition had persisted, brought new crops and stock and new methods into England Sir Richard Weston (1591–1652) who farmed in Surrey in Charles I's time, is credited with the introduction of turnips, clover and other sown grasses, and these crops providing winter keep were the foundation of the improved system of agriculture. With them cattle could be fattened and maintained during the winter; at the same time farmyard manure was made in quantity sufficient, with the help of the clover which enriches the soil in nitrogen, to raise enormously the whole level of production. The new farming could, however, only be practised on enclosed farms; on the open fields clover and turnips would be every man's property as soon as the common stock were turned on to them.

Turnips and clover were not the only introductions from the Low Countries; most of the common garden vegetables, as cabbages and cauliflowers, carrots and parsnips are owing to the same source. Fruit trees too were "fetched out of Flanders." Richard Harrys, fruiterer to King Henry VIII, bought "105 good acres in Teynham which he divided into 10 parcels, and brought plants beyond the seas and furnished the ground with them," which land "hath been the chief mother of all other orchards for these kindes of fruites." Hop growing also had a similar origin.

Doubtless the same thing happened with livestock, but here the evidence is more meagre because the descriptions of the early writers are so imperfect But it would seem probable that the large, long-woolled, white-faced sheep were originally of Roman origin and the Kents or Romney Marsh, the Lincolns and Leices-

ters, all on the eastern side of England, may well have been derived from a very similar sheep which is still found in Flanders. The importations may, indeed, have been earlier, for the English long wool was famous in mediaeval times and was among the first of the staple articles of export, its importance being still commemorated in the "woolsack" on which the Lord Chancellor sits. The earlier long wool chiefly came from the Cotswold country, the home of the other white-faced, long-woolled race of sheep, and this possibly may be a remainder from Roman occupation The black and white cattle which have always been about the eastern counties were certainly of Low Country origin—the modern Holstein-Friesian or Dutch cattle. It may even be surmised that white cattle of Roman origin (either directly or from the Rhine provinces) were progenitors of the Shorthorns, whose hybrid origin is betrayed by the mixed white and red colour of the roans.

**Enclosure Laws.**—The progress of enclosures grew apace in the 18th century. Whereas in early days it was opposed by parliament, in the 17th century it became possible to obtain sanction for agreements from the court of chancery, and from the time of Anne a strictly legal procedure by private act was made available (*see* COMMONS). Commissioners were appointed to make the award and apportion the several holdings to the tenants of the open arable fields, but a private act remained necessary until the General Enclosure Act of 1845.

Under the acts the commissioners could proceed to an award although a minority of the parties interested, one-eighth or even one-third, refused to agree. In certain counties—Suffolk, Sussex, Kent, Essex, Somerset, Devon and Cornwall, the marches of Wales, Cheshire, Lancashire and the four northern counties—enclosures were early and were but rarely effected by act. Possibly from the nature of the land the rigorous common field arable had never been usual in them. It was in the great corn growing areas of the Midlands, Yorkshire, Lincolnshire and Norfolk that so much enclosure by act took place in the 18th and early 19th centuries. After 1760 the process was much accelerated by the growth of industry and population even before the Napoleonic Wars created so great a call for good production. Valuable, indeed necessary, as enclosures were to the nation from the point of view of production, so great a change in the economy of the countryside could not be effected without much serious, if temporary, dislocation of labour and some permanent change for the worse in the condition of the poorer classes. Often the lord and the larger tenants took the opportunity of enclosure to put the land down to grass, so that a single shepherd would take the place of a dozen men who had formerly worked on the village land. The enclosures themselves may have been fair enough in their apportionments, though it would always have been easy for the lord and the bigger farmers to overweigh their poorer neighbours, but many cottagers who had no arable and therefore no title in the award found their customary rights of grazing swept away with the commons. There were those who held that the commons encouraged an idle race of casual labourers and poachers, but the other side of the picture, the destruction of a thrifty peasantry, was the theme of many writers in the 17th and 18th centuries.

Arthur Young, himself an unceasing advocate of enclosure, deplored the evils that had resulted therefrom. "By nineteen Enclosure Acts out of twenty, the poor are injured, in some grossly injured. . . . The poor in these parishes may say, and with truth, *Parliament may be tender of property; all I know is that I had a cow, and an Act of Parliament has taken it from me.*"

**The Agricultural Labourer.**—With enclosure began the creation in rural Britain of a race of landless men, dependent for employment upon the larger holders of land; and though the darkest days of this class did not come until the close of the 18th and the first third of the 19th centuries, when the pauperization caused by the old Poor Law became universal, the lot of the agricultural labourer, still the worst paid and worst housed section of the community, was established. Thomas Mozley wrote of his parish in Northamptonshire in 1829: "There were many farmers, several yeomen, very many small freeholders, as many tradesmen as the place could find work or customers for, and not one single labourer, in the sense of an independent workman offering his labour for wages, but a multitude of paupers."

The labourer class was also recruited from those yeomen proper who obtained small farms after enclosure but were unable to hold on to them. It required neither fraud nor force to displace the small proprietor; the mere pressure of economic change was sufficient A run of bad seasons, the constant temptation to mortgage, the inheritance by a widow, and the neighbouring proprietor who wanted to add land to land found his opportunity, especially where, as in England, land had for so long possessed a non-economic social value. Special opportunities were also offered to active men in industries and commerce, and since many of the old yeomen farms could produce but the barest living for their occupiers, they were sold and merged in larger holdings because the owners were no longer content with the income derivable from them In other countries peasant farming persisted largely because there were no alternative occupations with a higher standard of living within reach and because the layout of the land on the open

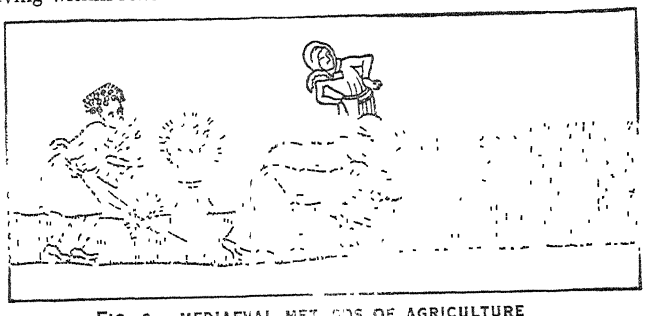


FIG. 3.—MEDIAEVAL METHODS OF AGRICULTURE
Reaping corn. From the Luttrell Psalter, an illuminated manuscript of the early part of the 14th century ("Vetusta Monumenta" vol. 6, pl. XXIII, fig. 3)

field system did not put an end to putting together large units of farming. The open field system nevertheless persisted into the 19th century; and even on the eve of World War II a nonenclosed parish farmed on the old English plan could be seen at Laxton in Northamptonshire and the parishes of Epworth and Haxey in the Isle of Axholme remained in strips, though the owners cropped them as they pleased.

**The Norfolk System.**—The improved methods of farming made possible by enclosure were soon manifest. Early in the 18th century what afterward came to be called the "Norfolk" or four-course rotation was being used. In consequence England became a grain exporting country during the first half of the 18th century, until the growth of population manifested itself with the development of industries. This epoch of British farming which became systematized in the early 18th century and endured until 1840, may be described as that of the conservation of the resources of the soil. The land was usually cultivated on a four-course system of two grain crops, alternating with turnips and a leguminous crop—clover or beans. The leguminous crop gathered nitrogen from the air and maintained the stock of this indispensable element of fertility at a comparatively constant level, despite the wastages that were going on. The turnips and the hay and straw provided for the making of farmyard manure, whereby there was returned to the soil the greater part of the valuable materials that the crops had taken out. Nothing left the farm except the nitrogen, phosphoric acid and potash sold away in the wheat and barley, the meat, milk and wool. Strict covenants prevented such wasting of the soil capital as would occur from the sale of hay or straw or roots, or the too frequent growth of salable grain crops. Under this system the average production became more than double that of the mediaeval farms Arthur Young spoke of 24 bushels of wheat as the average yield per acre; John Bennet Lawes, writing of Hertfordshire as he knew it when he began his experiments at Rothamsted about 1835, set the yield at 20 bushels, and the lower estimate is probably nearer the mark for the whole country. This level of production which may be compared with the six to ten bushels of mediaeval open field farming, could be maintained indefinitely. The limiting factor was generally the

supply of nitrogen, and this depended upon the recuperative actions of the leguminous crop in the rotation and of bacteria in the soil which made use of the organic matter supplied by the roots, the stubble and the straw, as against the removals in salable produce and the wastes that occur in the making of farmyard manure and in the soil itself under particular conditions, as leaching and waterlogging. The balance that was established was sufficient to maintain the yield at the level of 20 bushels of wheat per acre.

**Livestock and Other Improvements.**—Other improvements in agriculture were simultaneously in progress; great areas of waste land were being added to cultivation, especially on the heaths and light soils which before turnips and clover were introduced became immediately exhausted. Small's plow, the horse hoe, the drill, the threshing machine, were all inventions which took practical shape in the 18th century and did much to add to the effectiveness of the farming [illegible]. Drainage and the systematic amelioration of the land which had been impracticable on the open field system were taken up vigorously, though the wide extension of field drainage had to wait until the invention of drain tiles in the next century

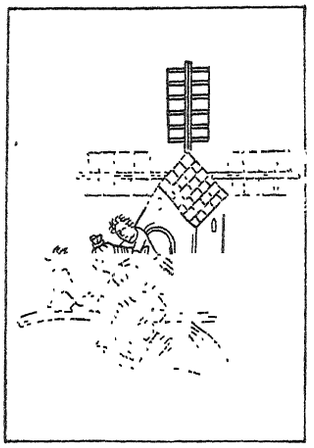


FIG 4.—MEDIAEVAL HUSBANDRY
Going to the mill. From the Louterell Psalter, an illuminated ms. of the early 14th century. ("Vetusta Monumenta")

Moreover, with the prevalence of enclosed fields, the improvement of livestock could be taken up with some prospect of rapid achievement. Robert Bakewell (*q.v.*) was the pioneer, and though he was unfortunate in selecting the Longhorn cattle to work upon, his creation of the Leicester breed of sheep persisted and led to rapid amelioration of all the long-woolled sheep. His methods were taken up by other men; Charles Colling made the Shorthorn breed, and John Ellman (1753–1832) the Southdown sheep which became the progenitor of all the other "down" breeds. England developed a race of breeders who combined the instincts of the fancier with certain definite principles. They began by selecting their breeding stock for conformity to an ideal type in which the meat was laid on in the most valuable places; by close line-breeding, even by inbreeding, the type was fixed and the "pedigree" sires became capable of stamping their own type in a few generations upon the common country-bred stock. Early maturity, the capacity to grow rapidly on good food, proved to be equally obtainable by selection, and the result was that in the 19th century Britain was possessed of a number of definite breeds of cattle, sheep and pigs that were doubly or trebly more efficient than were the old unimproved stocks. Their value may be gauged from the way the flocks and herds of the new countries of the world have been populated with stock of British origin. Shorthorns, Herefords and Devons are the great meat producers of the Americas, Australia and New Zealand; the only non-British breeds that achieved any world-wide extension were the Merino sheep because of their wool and adaptability to arid climates, and the Holstein-Friesian cattle because of their unrivalled milk yield.

**Capitalist Farming and the Great Landlords.**—The new agriculture which had grown up in response to the rapid increase of population under the beginnings of industrialism and had been overstimulated by the excessive prices that prevailed during the Napoleonic Wars, fell upon evil days with the break in prices and the restoration of a gold standard that followed the final peace in 1818. But it had accomplished its purpose of providing food for the nation from its own land, and it had completed the conversion of British agriculture from a system of peasant cultivation into one of capitalist business, small indeed in the main, but characterized by the employment of labour. In no other country did this development proceed so far. Prior to the disturbances arising out of World War I, most countries in Europe other than France, Switzerland and Belgium, could show vast estates farmed as single units and owned by the territorial nobility, but there was little or nothing of a middle farming class between the domain owners and the peasants, carrying on farming as a business on land rented from the large proprietor. In Great Britain the political, social and sporting privileges attaching to the possession of land early led to the building up of great estates, but the owner found the best use of his property in letting it again to tenants, who on their side took advantage of the opportunity for employing their limited capital in the business, by which they could derive a bigger income from it than if the greater portion were locked up in ownership of the land.

Thus in England the great landowners were the leaders of agriculture along its path of progress in the 18th century, even though most of the actual improvements, especially in stock breeding, were the work of tenant farmers like Bakewell, Colling and Ellman. A few large proprietors led the way and rendered better farming possible by their expenditures on reclamations and buildings.

They introduced the improved livestock to their tenants and they enforced sound methods of cropping by the covenants inserted in the conditions of tenancy. Prominent among them was the 2nd Viscount Townshend (*see* TOWNSHEND, CHARLES TOWNSHEND), Pope's "Turnip Townshend," who devoted himself to the improvement of his estate in Norfolk on a basis of turnip growing, with the use of the drill and the horse hoe. He is generally credited with the Norfolk four-course rotation, but it had been evolved before his time and he only gave to it a wider extension. The ideas that Townshend put into practice were chiefly derived from Jethro Tull (*q.v.*) of Berkshire, the greatest original thinker about farming processes that England had then produced. His *"Horse-Hoeing Husbandry,"* published in 1731, was the basis of all improvements in the operations of cultivation during the 18th and early 19th centuries. A little later Townshend's neighbour, "Coke of Norfolk," Earl of Leicester of Holkham (*see* LEICESTER OF HOLKHAM, THOMAS WILLIAM COKE) made a productive estate at Holkham of what had been little more than a rabbit warren, and became famous for his annual gatherings, the Holkham sheep shearings, where all the improving landlords and farmers of the day met and exchanged their experiences. There, too, the improved livestock of the time could be seen and judged. The duke of Bedford was equally active and held similar meetings at Woburn.

A little later the Earl of Egremont in Sussex, and in Scotland Hope of Rankeillor and Sir John Sinclair of Caithness, first president of the Board of Agriculture (1793–1822), may be singled out.

**Arthur Young.**—But the most active promulgator of the new methods was Arthur Young (*q.v.*). The younger son of a parson with a small property, Young began by farming, but with constant ill success. He soon found his proper *métier* in writing, and from 1767 to 1795 he published those vivid accounts of the farming and the men and manners of England, Ireland and France, which became classics of observation and shrewd judgment. In 1784 he began the publication of the "Annals of Agriculture," which embodied contributions from all the men of the time interested in agriculture, even the king himself. When a board of agriculture was established in 1793 Young became its secretary and was responsible for a series of county surveys of the state of farming in England which, if unequal and in some respects inferior to William Marshall's *General Survey of the Rural Economy of England,* remained the most trustworthy source of information. Young was pre-eminently a diffuser of knowledge; he had a sound knowledge of the general trend of agriculture, witness his unceasing advocacy of enclosures, and a quick eye for improvements of method. If his zeal sometimes outran his judgment in his commendation of innovations, his lively style always exacted interest and made him for 40 years a most effective stimulus toward the reform of farming. Rarely can a farmer be instructed in the method he is to follow, but he can be excited to think out a novel adaptation to his own conditions.

**Period of Scientific Progress.**—The accession of Victoria in 1837 marked the beginning of a new era in British farming. The occupiers of land had slowly adjusted themselves to the new conditions, after the shock caused by the break in prices at the end of the Napoleonic Wars. Confidence in agriculture was returning and a new race of landlords was growing up imbued with the idea that the scientific developments then in rapid progress could be applied to farming operations. In 1838 some of the leaders, among whom perhaps the most active was Philip Pusey, founded the Royal Agricultural society (*see* AGRICULTURAL SOCIETIES AND SHOWS), which gave a powerful stimulus to the improvement of stock, to experiments in cultivation and manuring, and to the introduction of machinery. Another small landowner, John Bennet Lawes (*q v.*) of Rothamsted, Herts., was beginning that fundamental series of field experiments which took formal shape in 1843 when he was joined by the young chemist, Joseph Henry Gilbert. At Rothamsted was laid the foundations of our knowledge of the use of fertilizers and the nutrition of animals. Previously there had been some empiric knowledge of the fertilizing value of such waste materials as woollen rags, soot and bones, but the supplies were limited and the employment only local. The first consignments of Peruvian guano and of nitrate of soda arrived in 1835; in 1843 Lawes began the manufacture of superphosphate, and his early experiments showed the value of the ammonia salts which could be made from the by-products of gas making, then becoming general. Other sources of phosphates than bones were rapidly discovered and about 1860 the great deposits of potash near Stassfurt, Germany, began to be exploited.

At the same time the science of agricultural chemistry was being explored and the theory of the nutrition of the plant—what it draws from the soil, the water and the air—a theory of which Justus von Liebig (*q v.*) had given a brilliant preliminary sketch in his British Association address, provided a rational basis for manuring. By 1850 the manufacture of artificial fertilizers was in full swing and though all too many farmers lagged behind in their application, their use, together with the employment of foreign feeding stuffs like linseed and cotton cake, the fertilizing ingredients of which found their way to the land through the manure made by their consumption, had by 1870 raised the general level of British production from 20 to 30 bu. of wheat per acre.

Other improvements influenced perhaps more the extension of the cultivated area than its increased yield. Field drainage was applied to great areas of heavy land under the influence of James Smith (1789–1850), of Deanston in Scotland, and of Josiah Parkes (1793–1871) whose demonstrations of the value of drainage became easy of application with Thomas Scragg's invention in 1845 of a machine for moulding cylindrical tiles. Smith drained shallow, 30 inches; Parkes put his drains in at 4 ft., and much of his work was in consequence wasted. Only after a great controversy between the two schools did it become clear that Smith's was the way to deal with ordinary heavy land which suffers because it cannot get rid of the rainfall, whereas Parkes' was the best method to cut off underground water rising from below. The improvements in cultivating machinery continued and in 1853 Crosskill put an efficient reaper at the farmers' service. The steam plow was designed and acquired a valuable if limited field of action. Pedigree stock made rapid progress; one by one the existing breeds of cattle, sheep and pigs became differentiated; breed societies and flock and herdbooks grew up. Improvements in crops also followed; Patrick Shirreff, John Chevallier, John Le Couteur and Frederic F. Hallet introduced the idea of "pedigree" into cereals.

From 1850 to 1874 farming was a prosperous business and money was poured into the land. British farming reached its high-water mark of technical excellence. It was reported that some farmers offered a reward to anyone who could find a weed on their cultivated land; no other country could show such yields of corn and roots; men came from all over the world to buy British livestock with which to improve their native races.

**Depression.**—All this prosperity culminated in the high prices occasioned by the Franco-German War; in 1874 a turn in the tide was manifest. A trade depression set in which limited the purchasing power of consumers; a run of bad seasons, culminating in the disastrous wet and cold year of 1879, brought ruin to many farmers. Other major causes beyond the control of farmers were at work to reduce prices. The growth of railways and the development of steamship traffic opened up the international trade in agricultural produce, and the wholesale settlement of new countries, particularly the western middle west of North America, gathered way. The area of the world devoted to wheat grew apace, faster even than the population; wheat prices fell year by year until 1894 The average *Gazette* price of English wheat was 54*s.* 3*d* for the decade 1865–74, 46*s.* in the next decade, and continued to fall to 22*s.* 10*d.* in 1894. During 1875–94, 124,000,000 ac of land were added to the cultivated area of the United States alone, and there were the corresponding increases in Canada, South America, Australia and New Zealand.

The other great factor was the appreciation of gold which began when Germany started to form a gold reserve after the war of 1870 and was accentuated by the falling yields from what had been the chief gold-producing centres of California and Australia. The situation was not rectified until the Transvaal became a big producer in the 1890s. The prices of all commodities fell, wheat more than the rest (according to Sauerbeck's index, all commodities fell 40%, wheat 51%), and some economists considered that to this cause alone was due the fall in agricultural prices and the resulting depression. But the vast increase of production must have also had its effect or the demand from the rapidly growing population would have counterbalanced it. During this period there was always a surplus of wheat and it was being grown at less than the cost of production, indeed it has been said that the only profit the pioneering American farmer made out of this situation was the eventual appreciation in value of the land he had settled.

Whatever the ultimate causes of the break in prices it had a disastrous effect upon British farming Neither farmers nor landlords realized how continuous the fall was going to be, or how completely indifferent would the price remain to the occurrence of a short crop at home; farmers could not readjust their methods and in many cases landowners did not reduce their rents in time to avoid a crash. Much of the old perfection of British farming had to go because of its expensiveness in labour, for during the whole of the period wages were tending to rise rather than to fall. Farm after farm was thrown upon the owners' hands; in Essex great areas of clay land became for a time derelict or were let to Scotsmen who would undertake to pay tithes and rates. In some cases the landowners had to farm themselves on an extensive scale; in others farmers who had acquired an art of cheap management had farm after farm thrust upon them until they were operating areas of 4,000 to 10,000 ac. These big businesses which grew up toward the close of the century were not reflected in the statistics, for the separate farms were still returned in the rate books as units. Indeed they were farmed as units, each with a bailiff but on the common system which the farmers had found to work; the buying and selling only were centralized. Though prices did turn slightly after 1895 it was not until the close of the century that the conditions began to appear at all stabilized. By that time men had learned to cheapen their methods in the purely arable districts and in others the growing demand for milk had afforded an outlet. The Essex clay lands came back into use, if not under the plow, with a new race of Scotch and Devonshire milk producers. Prices of meat and wool had fallen though not to the same extent as with cereals, and the distress in the west and north of England had never been so great as in the purely arable counties. In some districts special crops solved the farmers' difficulties; a great potato industry developed in the Fen country, where energetic men with intensive methods built up large holdings out of the bankrupt small farms; but the price of potatoes, like that of milk, was made at home, foreign competition being negligible there, while the demand grew with a larger and more prosperous population. The growth of vegetables, fruit and flowers also provided an expanding industry, and the demand for such things increased with the rise in the standard of living.

**Loss of Arable Land**—But such commodities provided the exceptions; in the main the farming community had to meet the depression by reducing expenditure, despite the resulting fall in production. The acreage only under wheat in England, 3,337,000 in 1872, had shrunk to 1,745,000 in 1900; yet there was no accompanying increase in the yield per acre such as should have attended the abandonment of the poorer land, without taking into consideration the improvements in the varieties grown and in the supply of fertilizers. The chief resort of the English farmer in order to meet the situation was to lay his land away to grass. Thereby he shifted his production toward the more remunerative livestock and at the same time reduced the labour bill, because on grassland one man may suffice for 200 or 300 ac., whereas on the arable land about four men per 100 ac. were then employed. Only when dairying on grassland, was a staff required comparable with that employed on the plowland. Between 1872 and 1900 the area of land under the plow in England was reduced by more than 2,500,000 ac., or nearly 20% of the amount in 1872. There were some notorious examples of these changes; in one case on the Berkshire Downs some 4,000 ac. of plowland were converted into a sheep ranch tenanted only by a few shepherds, the old farmhouses and hamlets perishing away in desolation. In England and Wales the agricultural population diminished between 1871 and 1901 from 1,269,371 to 951,674, or nearly one-quarter. In Scotland the reduction in arable land was not appreciable, but a similar saving was effected by lengthening the duration of the leys in the rotation; the four-course shift became a five- or a six-course, with two or three years of temporary grass instead of one. (*See* ARABLE.)

For all the reduction of cultivation and the lower standard of farming the period was not entirely one of retrogression. Improvements in the quality of livestock, especially in the direction of early maturity, in the production of milk, and in the special branches of potato growing, market gardening and fruit growing continued. The self-acting reaper and binder began to be imported in 1873 and proved the great labour-saving implement of the period, though at the outset it only intensified the pressure of competition, since it was worth more to the wheat grower in new countries short of labour than it was to the British farmer. This distressed state of agriculture became the subject of more than one royal commission and parliamentary inquiry, none of which, with protection ruled out as contrary to national policy, could suggest any substantial alleviation. The one legislative action of importance was the creation of the Board of Agriculture in 1889. This action recognized the importance of agriculture in the national economy, since no other industry had a special department in the government. The new board took over certain existing services such as the collection of statistics, the control of scheduled animal diseases, and the administration of tithes, enclosures, and university and college estates and was charged with one new function, the allocation of £5,000 a year for the assistance of agricultural and dairy schools.

**Agricultural Instruction.**—The first systematic attempt at agricultural education began about 1890, and in its train followed some new beginnings in research. The great start made at Rothamsted had been left solitary and unaided, though other countries were copying its methods and extending them into all the sciences which bear on agriculture. The movement was too young to have any effect on the industry before the close of the century; it had to overcome the intellectual inertia of a class which had always been indifferently educated and had no opinion of book farming, while the new scientific teachers had to learn what was good in the practical man's outfit and to recover from their own mistakes. One new fertilizer had been added to the list available for the farmer, namely, basic slag, a phosphatic by-product of the steel industry which was to do much to improve the growing area of grassland But owing to his poverty the British farmer was not using fertilizers as much as he might have done, and the greater part of the British production of sulphate of ammonia was being exported.

Steady recovery and quiet progress under the favouring wind of slowly rising prices characterized the opening years of the 20th century. Knowledge was growing, both from the example of successful practitioners and from the technical instruction that was becoming more generally diffused. Statistically the industry continued to decline; the arable land of England diminished by a further 1,000,000 acres between 1900 and 1914; nor was there any compensating increase in the numbers of livestock, though the output was improving as better methods of feeding and breeding brought the animals earlier to market. All over the country examples could be found of progressive and prosperous farmers who were taking advantage of the resources science was increasingly putting at their disposal. But many were still set in old ways; mindful of the bad times that were not far off they sought the path of safety first and were distrustful of all enterprise that might cost money. In the use of lime, fertilizers and other ameliorations of the soil the farmers were falling behind their competitors in the Netherlands, Denmark and Germany, just as in the applications of machinery they could not rival the farmers of the U S. and Australia. Labour was still too cheap in the agricultural counties of England; farmers still clung to the traditions that had answered when wages were 7*s.* a week and wheat over 6*s.* a bushel.

**Marketing.**—Above all the weakness of British agriculture as an economic unit was being exposed. The rapidly growing population was to an increasing extent being fed from overseas; in the five years preceding 1914 the United Kingdom only produced 42% of the food it consumed as measured in calories, including only 20% of the wheat it needed. Great Britain was the one open market for the agricultural surpluses of the whole world, for the one or two small countries that also persevered in a free trade policy were themselves exporters of agricultural produce. In consequence great commercial interests grew up to exploit this import trade, interests that could impose upon the aspirants for a place in the British market those conditions of uniformity of produce, standardization of output, and attractiveness of packing, which made for ready sale. Because of their dependence upon an export trade competitors were marshalled into co-operative societies, and through this discipline the peasant farmers of other countries secured all the advantages of marketing which might have been expected to belong only to the big businesses. The typical British farmer, who in his day had been a nonefficient unit for the sale of his staple produce and could look down upon the exploitation of the peasant was loath to forgo his individuality and slow to [illegible] weakness in the world's markets. The lack of leadership and organization was all a part of the want of public confidence in an industry which had become somewhat remote from modern life. The great landowners no longer regarded agriculture as a money-making business; they maintained home farms because of the traditional association of the English gentleman with the countryside and because the exhibition of pedigree stock was a recognized form of social competition; but the lawyers, the bankers and the capitalists remembered the past and had no belief in the earning capacity of the land. No joint stock enterprise to produce food at home could hope to obtain public support, however much money might be forthcoming to exploit wheat or wool, tea or rubber or copra abroad. The farmers who were making money said little about it and trusted to obtain whatever capital was needed for their businesses, many of them extensive, from their friends or trade connections. Politically the farming interest did not count; in parliament there could be no agrarian party, hardly even an agrarian member, because even in a purely rural constituency the more numerous labourers were not likely to vote with the farmers. Nor was there any policy upon which the agriculturists were united; although most farmers were still protectionists, such a measure was taboo to all parties so far as concerns food and even with the agricultural labourer the dread of higher prices outweighed the hope of better employment.

The one political measure of outstanding importance was the Small Holdings Act of 1908 which empowered county councils to acquire land and equip it for small holdings and allotments (*see* ALLOTMENTS and SMALL HOLDINGS). This act was a sign of growing public interest in agriculture and a feeling among thinking people that the urbanization of Great Britain was proceeding too fast and that some measures should be sought to check the drift of men away from the land. The triumphal march of industrial-

ism from factory to factory had lost some of its attractiveness; statesmen no longer regarded the simple theory of Great Britain wholly given up to manufacturing and exchanging its goods for food, as desirable or even safe. So the Small Holdings act was an attempt to recreate the peasantry that had long been dying out in Britain, and to provide access to the land for men whom circumstances had driven into the towns but who still felt a call to the soil. The growth of small holdings could do little toward reducing the volume of imports; the impulse was social rather than economic, but a small holding might give the energetic man a start toward a larger farm. The statutory small holders rarely failed to establish themselves, but their numbers barely sufficed to keep pace with the wastage that was elsewhere going on (*see* SMALL HOLDINGS).

**The Development Fund.**—Another measure of perhaps more far-reaching consequences was Lloyd George's Development Act of 1909, by which was set up a commission endowed with ample funds, the function of which was to promote research and education in agriculture and to carry out other experimental work in rural industries which might help to restore prosperity to the countryside Thanks to this fund British agriculture began to be provided with an adequate establishment for research and investigation, such as the United States, Germany and other progressive countries already enjoyed. Some results from research were already accruing The plant breeder's improvements were quickly recognized by farmers, and Rowland Biffen of the Cambridge School of Agriculture and E. S. Beaven of Warminster, working independently, had applied Mendelian principles to the breeding of new varieties of cereals. Some of Biffen's wheats and Beaven's barleys were already being widely grown by farmers in the progressive districts and their success did more than anything else to convert farmers to a belief in the value of research.

Toward the close of the period the tractor plow, driven by an internal combustion engine, began to appear. It could be operated on a farm of ordinary British size, whereas the steam plow was only economic on an extraordinary acreage and had become an emergency implement only hired for special work. Imperfect as the motor implement was, it offered potentialities of speeding up and economizing manual labour which have not as yet been fully realized.

**World War I.**—War halted these forces of quiet progress. Its first effect was to sweep the agricultural colleges and research institutes of their students and younger staff members for military service. For the first two years of the war the farmers were told to carry on their work as usual. Prices rose steadily but not abnormally, though here and there special shortages developed. It was not until the submarine campaign became ominous in 1916 and harvests at home and in the U.S. were deficient that the government deemed a special agricultural program vital.

Early in 1917 the Board of Agriculture under the presidency of Rowland E. Prothero (later Lord Ernle) set up a Food Production department directed by Sir Arthur Lee (later Lord Lee of Fareham), and county committees with power to direct the crops to be grown were constituted. Little could be done to enlarge the area under crop in 1917, but each county was assigned an area of land to be put under the plow for corn and potatoes. Attention was also given to land inadequately cultivated. Services were organized to provide and distribute steam and tractor plows, horses and implements. Labour was recruited from every possible source, including interned persons and prisoners of war. Many women helped, training centres being set up to make them and other unskilled labour serviceable. The supplies of seeds, fertilizers, feedstuffs and other necessities like binder twine were organized, and the necessary transport and credits for purchases overseas were arranged. Although late, the program was prosecuted with great vigour, and even in 1917 the area devoted to wheat, barley, oats and potatoes was considerably increased. The cultivation in allotments of all spare ground near cities and towns was promoted. This movement (*see* ALLOTMENTS) was of no small value in mitigating later food shortages.

To meet the emergency and also provide a permanent policy of encouraging agriculture for the national welfare, the Corn Production act was passed in 1917. It guaranteed certain prices for cereals, but the rapid rise of prices rendered the provisions unnecessary during the war. It also provided for wage boards to determine minimum wages for agricultural labour from year to year in each district, but the price situation developed so rapidly that the boards fixed the actual rather than the minimum rates Landowners were debarred from raising rents in so far as such increases could be ascribed to the guaranteed prices. The act sought to maintain and extend the area of cultivation, and regardless of its defects it was the first coherent scheme that recognized the needs of all classes interested in the land.

The course of prices was of more immediate interest to the farmers. Early in 1917 shortages attended by rapid rises of prices and speculation among dealers forced the newly formed ministry of food to fix prices and then ration all major articles of food These steps involved a very complete control of all phases of distribution; prices had to be fixed for both the producer and the consumer, the middleman's allowances were determined, and the supplies had to be allocated to the needs of each district. The food controller had to compromise between the high prices necessary to stimulate production and the low prices required by the consumer. The consumption of bread was left uncontrolled, but its price was kept down by a subsidy. It was also necessary to fix the prices on much of what the farmers produced on a reasonable parity so that they would not be tempted to concentrate on the production of the most profitable. A shortage in cattle food developed since the rationed ships' tonnage for goods from overseas had to be reserved for essential human foodstuffs, soldiers and munitions. The normal home production of cattle food was likewise reduced because wheat was milled more deeply and this produced only 5% or 6% offals as compared with 30% before the war. Actually the milk herd of the country was not appreciably reduced, but the sheep population declined by 1,500,000 between 1916 and 1918, and the pig herd declined from nearly 2,500,000 in 1914 to 1,700,000 in 1918.

During the latter part of 1917 and early 1918 the program of the Food Production department and its county committees found a real response. In 1918 as compared with 1916 the total arable land of the United Kingdom was increased by 1,720,000 acres and the land under crops by nearly 3,000,000 acres, the increase in wheat being 750 000 acres, in oats over 1,500,000 acres, and in potatoes nearly 400.000 acres. But the withdrawal of more men for military service in the spring of 1918 and the disastrous harvest conditions so intensified the opposition to compulsory plowing that no further progress was made. In fact the acreage in grain in 1919 was nearly 500,000 less than in the preceding year. With the end of the fighting in Nov. 1918, the farmers turned very strongly against control, despite the persistence of the crisis of food supplies

**Effect of World War I on Farming.**—The consequence of the war conditions which persisted until near the end of 1920, when the food controller's operations were relaxed, was a great temporary prosperity for the farmers. Although they had to sell their wheat at less than the world price and the cost of labour and supplies rose to a high level, rents did not vary and the balance was strongly in their favour. They also enjoyed the benefit which affects all farming operations, namely that on a rising market some of the costs, particularly labour, are incurred on a lower scale than that of the realization. While the largest sums of money were realized from potatoes and vegetables, probably the highest rate of profit was on the grazing farms which sold sheep and wool, young stock and milk, and employed little labour. But the only men who really kept their profits were those who gave up their farms and sold their stock before the end of 1920.

The most immediate effect of these farming profits was a sharp rise in land values. During 1918–21 there were immense sales of agricultural land amounting on a conservative estimate to 3,000,000 ac. in England and Wales. About one-eighth of the farming area of the country changed hands in these years at greatly enhanced values. Landowners were not able to raise rents though their disbursements for tithe, repairs and taxation had increased, farms being in demand, they could treble or even quadruple their

net incomes from land by selling it and investing the proceeds in government stocks. Tenants were anxious to retain their holdings but had to buy in order to do so.

Consequently these years saw the creation on a fairly large scale of an owner-occupier class of farmer. Some of these men had already made money enough to pay for their farms or were able to do so while prices were high; they were comparatively safe when the crash in values came in 1921. The men who then found themselves in difficulties were those who had bought their farms on borrowed money and still carried the mortgage; still more those who had entered and stocked their farms in the period of high prices.

Considering the production of the country the advance in the arable and particularly in the grain area attained in 1918 was not maintained even in the years of high prices that persisted until 1921. All powers of dictating cultivation were abandoned at the close of the war As regards livestock the size of the milk herd was maintained, though the beef herd suffered a small decline. The sheep flock of Great Britain, of England in particular, was greatly diminished; in England and Wales it stood at about 17,500,000 at the beginning of the war, had fallen to 16,500,000 in 1918 and reached its lowest point, 13,383,000 head in 1921, while analysis of the returns shows that the loss had fallen almost entirely upon the sheep of the arable counties. Arable sheep farming had always been a special British feature characteristic of the open country upon the chalk and the sands. There half the arable land used to be farmed with fodder crops—rye, winter barley, tares, rape, kale, turnips and swedes, which were sown so as to afford a succession of green crops upon which the sheep were closely penned in folds that were moved day by day on to fresh ground.

In addition to their green food the sheep and lambs received a little hay and corn and cake to force them on for market at an early stage; the land received the benefit of the manure made from the food and the treading of the sheep. This system, the sheet anchor of the older light land farming, was unsuited to war and postwar conditions. The labour required, both for the fold and the growing of fodder crops, was too expensive at the new wage rates, the supplementary feeding stuffs were unobtainable, and prices tempted the farmer to sell all his flock and put the land into grain. Again fixed prices ignored quality; the arable sheep farmer could no longer realize the extra price he had been accustomed to obtain for his quickly-grown lambs. Consequently the great arable sheep areas in Hants, Wilts and similar counties lost up to 50% of their sheep and though their numbers revived later the restocking was with grass breeds like the Cheviot-Border, Leicester half-breeds, Exmoors, Kerry Hills, etc., to the permanent loss of the Down breeds, like Hampshires, Oxford Downs and Southdowns.

The stock of pigs suffered great reductions with the shortage of feeding stuffs in 1917, 1918 and 1919. The herd which in England and Wales had remained for many years at about 2,000,000 fell to 1,700,000 in 1918, but recovered rapidly to more than its previous level, reaching 3,250,000 in 1923. The numbers of poultry followed much the same course as that of pigs and from the same causes, but the postwar development was more marked with the rapid extension of the knowledge of skilled poultry management.

**Depression of the 1920s.**—War prices were maintained until the spring of 1921; then they dropped by about one-third by the close of the year The prime cause was the deflation of money in Great Britain and the U.S. which was then effected; the secondary causes were the abundant harvests in the vastly expanded area of cereals in the Americas, particularly in Canada, and the lack of purchasing power among the war-ruined population of Europe. Prices in Britain continued to fall until 1923, then tended to recover a little until the long-continued coal strike of 1926 produced a new fall which specially hit the class of farmers who had so far suffered least namely, the producers of milk and meat. The situation was aggravated by a succession of bad seasons after 1918, which of themselves would have hurt the position of farmers even in normal times. Bad growing seasons, wet harvests and foot and mouth disease, were serious contributory factors in the ruinous condition in which British farming found itself. Deflation alone wrote off nearly half the capital farmers estimated they possessed in 1921, and though this did not really alter the position of men who had been farming continuously from before the war, it fell heavily upon those who had entered farming during the years of high prices or had mortgages out from the purchase of their farms.

**Postwar Legislation.**—The state of agriculture was not without consideration and legislative action during the period after World War I. War experiences persuaded both parliament and the general public that the maintenance of a prosperous agriculture was of some moment in the national policy. Even during the war a reconstruction committee under Lord Selborne had examined the question and drawn up a series of recommendations on which the Corn Production Act of 1917 had to some extent been based. But that act, as already seen, had immediately become nugatory as far as guarantee of prices was concerned. As the outcome of a royal commission in 1919 an Agriculture act was passed in 1920, which accepted the main principles of the old act by charging the state with the payment of subsidies on the acreage of wheat and oats grown, whenever the prices fell below the assessed costs of production. The county agricultural committees became statutory bodies endowed with powers to determine tenancies in case of persistent bad cultivation or neglect, and even to enter upon the land and act themselves in cases of default Wages boards were continued and tenants were given greater security of tenure by provisions which compelled the landlord to give compensation for disturbance equivalent to a year's or even up to four years' rent, unless the county agricultural committee would certify that the notice to quit was justified by the bad cultivation of the tenant. The Agriculture act had, however, but a brief existence. It antedated by only a few months the break in prices of 1921, and it soon became evident that under the guarantees the state would be called upon to pay a very large sum upon the acreage of wheat and oats grown. The basal figure had in fact been set much too high for oats, a crop which is mostly consumed upon the farm and which therefore does not greatly affect the income of the farmer. But no attempt was made to remedy this defect; the public cry for economy was so insistent that the act itself was repealed in 1921 within ten months of its passing, in spite of all the promises set out in the act that four years' notice would be given before the guarantees were withdrawn. The repeal coincided with the very situation the act was designed to obviate, a wholesale break in prices brought about by causes beyond the control of the farmer, and in this case by the deliberate deflation policy of the government. With the guarantees the wages boards disappeared and though conciliation committees were set up in most counties, the average weekly wage dropped from 42*s.* in Sept. 1921, to less than 28*s.* before the end of 1922. The repeal of the Agriculture act put an end to all ideas for a national constructive policy for agriculture and the industry was left to sink or swim by its own powers and be guided by its own lights. The action was part of the pessimism of the time, of the war weariness that shirks any sustained effort and doubts the value of any planning for the future. Bitterly as it was resented by the farmers, who thereby lost all confidence not only in governments but in agriculture itself, it was angrily acquiesced in, because they got rid of their two greatest bugbears—the shadow of control of farming and wages boards. The resentment generated by plowing-up orders given in 1918 and other interferences consequent upon the orders of the food controller, had been worked up to an intensity out of all proportion to the actual hardship that had been inflicted, and farmers generally were prepared to purchase freedom at any cost. A very large proportion of them indeed grew little wheat or oats and were anxious to grow less in the difficult state of arable farming. So the farmers' representatives, while protesting, accepted the situation; they saved those sections of the act that gave them compensation from disturbance (provisions which injured the landowners and were in many respects a hindrance to the improvement of farming) and they obtained as a slight recognition of the sacrifice imposed upon them the allocation of £1,000,000 to the extension of agri-

cultural research and education.

After the war the National Farmers' union, in which was concentrated the political opinion of the farming community, objected to any further interference of the state with agriculture. The distressed state of the industry gave rise to a further inquiry in 1923—the Agricultural tribunal, consisting of three economists not directly connected with agriculture, who produced an illuminating survey of the subject early in 1924. Its main recommendation, a subsidy upon arable land with further assistance to the growth of wheat, received little support from the farmers' organizations and was never adopted by the government of the day. It also recommended the re-establishment of the wages boards and this was effected in 1924. An act in 1922 disposed of a long-standing controversy by permitting the admission of Canadian store cattle into Great Britain, and the Agricultural Credit act of 1923 gave some relief in the shape of cheap mortgages to farmers who had purchased their holdings during the operation of the Corn Production and Agriculture acts. The British Sugar (Subsidy) act of 1925 provided a very ample scale of subsidies on sugar produced in Great Britain, for a period of ten years, in order to encourage the establishment of a sugar-beet industry in the country.

**Wages and Prices.**—The low agricultural prices of the 1920s and 1930s were not due to overproduction, since as far as can be estimated the gross output from the land of the world, actually lower in some items, did not keep pace with the growth of population after 1914 (*see* below, *World Agriculture*). That this shortage did not result in higher prices was due to the destruction of the purchasing power of so many of the countries of the world, through war and revolution and the depression in industries. The efforts that so many states made toward a deflation of their currency was regarded by many economists as the immediately operative factor, depressing prices for all producers and destroying the confidence upon which industrial activity depends.

The other element in the equation—the relatively high cost of labour—could not be met in England by a reduction in the wage rate, which in agriculture was already below that prevailing in other industries. Indeed, bad as was the state of trade, men left farming for other occupations; many farmers complained of the shortage of labour, and in certain cases where profits were assured, as in sugar-beet growing, labour from Ireland was imported. Any local call for men immediately drew agricultural labourers from their following and when any general revival of industry took place the land was likely to lose most of its active and able-bodied men. Thus if no other change supervened, farming, except for those special businesses that could command a sheltered or a luxury market, was reduced to a species of ranching with a minimum of labour. There was one alternative—a sustained effort to make labour more effective, on the one hand by better organization, by the use of machinery and the elimination of wasted effort, and on the other by careful training to increase the skill of the individual. Much of what was called "good" farming before World War I was still dealing with labour on a mid-19th century basis of wages, and though operations had been cheapened after the fall of prices of the '80s and the '90s, there had been no radical reconsideration of methods such as was called for by the modern relation of wages to the prices of agricultural produce. This was the big problem before British agriculture—the revision of all its traditions of husbandry, and it required the co-operation of the investigators, both scientific and economic, with the study by individual farmers of the conditions imposed by their own farm and particular business. The investigators might supply stimulus and guidance, but the main effort would have to be exerted by the farmers themselves, for the problem was one of management and practice, demanding a consideration of the technique of farming and the arts of leadership and management that had not been forthcoming for the last two generations. Some encouragement and renewal of confidence could come from increasing prices, for the withdrawal of men from the land because of the superior rewards in other occupations was not confined to Great Britain but was common to all countries. It affected the peasant as well as the wage-earning labourer; it was manifest in the United States as in France.

**Agricultural Co-operation.**—The obviously attractive advantages which can be obtained by buying and selling on a wholesale scale and the great success attending co-operative effort among farmers abroad, particularly in Denmark, caused agricultural co-operation (*q.v.*) to be pressed upon the British farmer for many years. The work of propaganda and advice was undertaken by the Agricultural Organization society, which was modelled on the successful Irish society initiated by Sir Horace Plunkett The A.O.S. was a voluntary organization supported by subscriptions from its affiliated societies, but it enjoyed a considerable amount of subvention from the Development fund from 1910 to its demise in 1924. The earlier efforts at co-operation chiefly aimed at the formation of purchase societies to supply the farmers' requirements for fertilizers feeding stuffs and other materials. Though many of these ventures had but a brief existence some became strong trading corporations, such as the Eastern Counties Farmers' Co-operative society at Ipswich. A wholesale society, launched during World War I with the object of bulking the purchases of individual societies, came to disaster. Little progress was made with societies for the sale of farmers' produce, though a number of [illegible] depots flourished. Dairy societies had a somewhat [illegible] existence; in some cases as soon as they attained local success they attracted the attention of one of the big dairy firms and after a period of fierce competition either succumbed or were brought out. Eventually the Agricultural Organization society, despite all the devoted work given to it and the subventions it had enjoyed, found it necessary to dissolve. It had never received any wide measure of support from farmers, and as the National Farmers' union had become the representative organization of the farmers of England and Wales and was prepared to take over the care of co-operative action among its members, the old society gave way to the National Farmers' union. At the same time the government under the Agricultural Credits act made provision for loans to Agricultural Co-operative societies on the basis of a loan of 20*s.* for each 20*s.* share taken up by members, of which no more than 5*s.* need be initially called up. The history of these latter ventures was not altogether encouraging. At the same time there was a movement for the setting up of co-operative bacon factories on Scandinavian models. Seven such societies were started. Two active wool-selling agencies were established, one in the southeast and one in the northern counties, both of which steadily progressed. In 1925 on the termination of the wartime hop control, a voluntary organization to continue the collective sale of hops succeeded in enlisting some 90% of the hop growers of the country. While other examples could also be named, speaking generally, agricultural co-operation made but little progress among the farmers of England.

The reasons are not far to seek. In the first place the larger English farmers make their purchases on a big enough scale to secure terms comparable with those offered by the co-operative society. When such men joined a purchasing society they were apt to use it merely to beat down the terms offered by their merchants. The smaller farmers followed the lead of the big men or were unable to forgo the credit they obtained from the merchants. Again the firms dealing in agricultural necessaries were very firmly entrenched in Great Britain; many of them were bigger and more efficient than a newly-started co-operative society could be, and having capital behind them did not shrink from competition They had the great advantage too of being able to offer credit, and their agents being generally drawn from the farmer class had friends and connections among the men with whom they wanted to do business.

Societies for the sale of farmers' produce had an even more difficult task. Trade rivalry was equally strong; the customary markets were close at hand and farmers were loath to forgo their individuality or renounce the chance of a temporary rise of prices. Co-operative selling involved working to contract and the production and regular delivery of a standardized article. The bacon factories failed largely because they could not ensure a regular supply, the farmers diverting their pigs to other channels when

prices rose. Firm contracts to deliver regularly were refused by the producers or could not be enforced. Milk societies were compelled by their members to give a price too high for successful working because a competing trader with a long view would offer prices above the economic parity. Certain ventures failed also from embarking upon a manufacturing process, like bacon curing, which requires a considerable degree of technical skill, and the inability of the society to pay a competent manager or else to find one before its resources went.

The existence of a near-by market is the great obstacle to agricultural co-operation for the sale of produce. Nearly all the examples that are so freely quoted of the success of farmers' organizations—the bacon factories of Denmark or the fruit-selling associations of California—rest upon the fact that only an export trade is available and that farmers cannot engage individually in such a trade. They are driven to organize because the alternative is the control of a wholesale trader who cuts the producers' returns to the minimum that will keep them in business. For these and other reasons the true co-operative spirit was lacking, and British farmers did not show that loyalty to the principle of combination which would induce members to stick to their society even at the cost of some loss to themselves. When there is an old-established market at hand it is almost impossible for a co-operative business to give the farmer better returns at once. Psychologically, too, defaulters and men who stand outside a combine have a powerful disintegrating influence upon it. They share in all the benefits if the combine succeeds in raising the general level of price; they take no risks and get paid at once, while members may be waiting for a portion of their returns because the society has only succeeded in raising prices by withholding part of the crop from the market. The "outsiders" would not be human if they did not boast about their advantages, and English farmers were as yet too easy-going and too much merged in the general community to counter with a social boycott. Similar occurrences in certain of the British dominions resulted in legislation to force recalcitrants into any combination which secured the adhesion of three-quarters or four-fifths of the producers; but such procedure was quite alien to the English farmers' declared policy of "no control." Yet the acceptance of voluntary control is the essence of co-operative organization, and by virtually compelling farmers to produce the article wanted by the market, rather than that which they fancied, exerted a powerful educational influence. On the other hand if he did not accept the voluntary control of his own organizations the British farmer was likely to drift into subjection to the much less sympathetic control of big businesses which would make of him a tied producer.

Thus the prospects of agricultural co-operation did not appear bright, though the situation was not without hope; a sense of the necessity for combination was growing. Nothing could be gained by preaching co-operation at large, but little by little particular instances were making good, especially where the association only attempted to sell and not to manufacture the raw material provided by the farmer. An alliance might be possible with the great co-operative organizations among consumers, which indeed had hitherto been spending their efforts in organizing foreign rather than home producers. But it was only by combination of some sort, from within or from without, that British farmers could hope to retain a remunerative share of the best of all agricultural markets—that of Great Britain. (*See* AGRICULTURAL CO-OPERATION.)

**British Farming Systems.**—British farming is characteristically an affair of small capitalist businesses employing paid labour. Characteristically, too, the farms are tenancies held under yearly agreements, though the tenant is largely protected from disturbance by the Agricultural act The landowner provides the permanent equipment of the farm buildings, gates and fencing, water supply, drainage. The landowner also is responsible for repairs to the fabric, but minor improvements of which he will remain possessed are generally carried out on the basis of the landowner finding materials—timber for fencing, bricks, stone, gates, drain tiles, seeds for permanent pasture, etc., and the tenant finding the labour. The landowner's capital has been estimated to amount on the average to £31 per acre, the tenants to £12–£15 per acre, and the average rent to 31*s.* per acre. Under such a system the entry upon and leaving of a farm, at whatever date, necessitates a considerable adjustment of account between landlord and tenant, since the farm must be left as a going concern. These adjustments were formerly regulated entirely by custom and though they were now governed by the various Agricultural Holdings acts (consolidated in 1923), custom was recognized and still played a large part. The basis of the act was that the outgoing tenant was entitled to compensation from the landowner for all improvements he has effected, the amount of compensation being determined by the value of the improvement to the incoming tenant. For certain types of permanent improvement, *e.g.*, buildings, fruit trees, etc, the tenant was not entitled to compensation unless the consent of the landlord had previously been obtained. The purpose of this exclusion was to prevent the tenant from committing the landowner to payment for an improvement which the latter might not be able to realize. For example the improvement effected by planting land with fruit or hops might be valued as high as £100 an acre, with embarrassment to the landowner if he had to pay out this sum on the determination of the tenancy without any assurance of being able to find a tenant willing to pay an adequate rent for it. An exception was made in the case of holdings let as market gardens. Here general legislative sanction was given to what was known as the "Evesham custom." The tenant possessed the right of free sale of the improvements he had made, *e.g.*, beds of asparagus, fruit plantations, etc., but had to find the purchaser, the landowner being obliged to accept the tenant proposed by the outgoing tenant, who had made his own bargain for the improvement with the new tenant.

In ordinary cases the negotiations with regard to improvements proceeded between the outgoing and the incoming tenant, in whose agreement with the landowner was a clause that he should pay whatever compensation was due to the outgoer. Each tenant appointed a valuer who between them prepared an agreed valuation of the tenant right, there being provision for an arbitrator in cases of dispute. The account included the cost of cultivations carried out before leaving the tenancy, standing crops and manurial residues whether of fertilizers applied or purchased feeding stuffs consumed during the latter years of the tenancy; but as farms were vacated at different dates in different parts of the country, though most commonly at Michaelmas or Lady day, custom still played a large part in determining both what things were the subjects of compensation and the basis of assessment.

**Tenancy.**—The British tenancy system possesses many advantages. The handicap that farming is under as compared with other industries lies in the large amount of fixed capital involved in comparison with turnover and in the lag that exists between expenditure and returns. For the farmer who has to own his farm this implies a considerable degree of credit, and in other countries it has generally been found necessary to give some state support to landbanks or other long term credit organizations which will take the burden of the capital outlay on land and buildings. The short term credits required for the conduct of the business proper are supplied by co-operative associations or the banks. Otherwise mortgages rule and mortgages have universally proved destructive to the farmers whenever a run of bad seasons occurs. In Britain the landowner has supplied the cheap capital the industry requires for its permanent equipment, and the banking system so far pervades the community that it can furnish a not unreasonable proportion of the working capital the farmer should have. Even so the farmer would have to work upon a much smaller proportion of borrowed capital than prevails in other business, and in practice in Britain the farmer resorts to a dangerous extent to the tradespeople with whom he deals. The merchants who sell to him his requirements in manures and cakes and buy from him his grain and hay, and the auctioneers through whose hands pass the store cattle he buys and the finished cattle and sheep he has to sell, provide to a very large extent the financial backing of the industry. This custom obviously limits the power of the farmer to buy and sell in the best market, and it was pro-

posed by legalizing the creation of chattel mortgages to enable the banks to accord greater credit facilities. The farmer could then assign his livestock or his standing crops as security for advances.

The tenancy system undoubtedly assisted in the development of British farming in the 19th century, though it produced a certain number of cases of oppression when the power of the landowner to turn out a tenant for causes unconnected with farming remained unrestricted. The condition, however, of success in a tenancy system is the possession by the owner of a real knowledge of, and interest in, the conditions of farming. He (or, in the case of large estates or other interests, his agent) must have considerable technical knowledge, if he is to be a working element of the system, the adviser and leader of his tenants. The declining interest of landowners in agriculture and the inadequate training of so many of the agents employed by them were a main cause of the weakness that the tenancy system displayed and its hampering effect upon enterprise and innovation among the farmers. Many people, therefore, aiming at a return to a system of occupying ownerships pleaded the necessity of freedom for the cultivator and the stimulus of the "magic of property"; though it would be within the experience of those who had occasion to survey the countryside in detail that even if some of the best, so also many of the worst-managed farms are the property of their occupiers. Further in a modern state no ownership system persists; minors, females or men with other interests inherit, and the new owners prefer to let rather than to sell. For these reasons it was argued that the welfare of the industry demanded the state ownership of all agricultural land and a stricter exercise of the continuing owner's interest in good farming.

**Small Holdings.**—Other observers who were impressed by the straits of wage-paying farming, even at the low rates for agricultural labour, sought a solution in a break-up of the larger holdings characteristic of British farming and a return to the peasant system of family farms, still customary in most parts of the world. Even in the depression of the 1920s flourishing colonies of small holders could be found in many parts of the country, and the creation of small holdings was attended by an increase in the production from the soil. For instance in the vale of Evesham grass farms on clay land which were indifferently grazed and yielded but a poor return of milk and store stock, became intensively cultivated for asparagus, plums and other vegetables and fruit; where there had been perhaps one man employed per 100 acres, the small holders would make a thrifty living on 15 acres of the new cultivation Consideration of such cases led to the Small Holdings act of 1908 and to a widespread demand for a general policy of dividing up the land. It was doubtful, however, whether the admitted success of small holdings was a sufficient basis to justify their general application to British conditions. The success of small holdings depends upon two factors. The small holder, being his own master, works harder and more intelligently and for longer hours than the paid labourer; he also throws in the work of his family, often of considerable amount. Large farmers would agree that if they could get from their labourers the quality of work put in by the small holder they could pay wages even higher than the returns obtained by the small holder. Small holders, therefore, are concerned with the production of those things in which manual labour bulks largely, but also they must engage in a branch of the industry that has a rising market, and preferably one that is naturally protected. With their ears to the ground they have been quick to seize upon small things that the large farmer neglects. Milk, potatoes, vegetables, fruit and poultry, and occasionally pigs have been the produce upon which the small holders have depended. They rarely touch the main lines of farming—grain, beef, or sheep and even with milk they often make their profit by combining retailing with production. Thus the opportunities for small holding are limited and the markets they cater for are easily overstocked, although as regards milk and vegetables they had reaped the advantage of a demand that had been steadily rising for years. As a rule small holders require good land and can make little use of the great areas of the chalk and clay soils.

While it is generally agreed that small holdings are unsuited to the production of grain or cattle and sheep breeding, it is argued that even these branches of agriculture could be pursued if they were organized for the co-operative use of machinery, pedigree sires, etc. But this is only equivalent to saying that small holding farming could be successful if imperfectly and by agreement it adopted the methods of large farms. Co-operative farming has not been realized and the mark of the small holder is his independence; as a rule he has only become united with co-operative selling societies when he has been under the necessity of working for an export market. Nor is there necessarily any greater production from land under small holdings; in the instance quoted above the increases are due to a change in system introduced by the small holder. But the large-scale fruit grower or market gardener or milk farmer will produce more per acre and that of better quality than the small holder working single-handed. Organization and the command of capital in the large businesses tell even against the individual attention which is the asset of the small holder; spraying is more suitably undertaken on an extensive scale; clean milk more often comes from the large herds. The greater production per acre of the small holder is often a consequence of the more intensive farming which he is forced to adopt but which would be uneconomic if the labour had to be paid for There are thus two cardinal difficulties attending upon a revival of a peasant system of farming in Britain, one economic, the other social. The economic drawback is the higher capital outlay involved; the creation of a colony of small holdings necessitating expenditure on buildings, roads, fencing, water supply, etc., that is much greater than would be required on a farm of equal area and engaged in the same type of farming. But it is not germane to quote the excessive cost of the small holdings set up after the war, which reached £2,000 and upward per holding, because at that time no farm, large or small, could have been equipped on bare land so as to produce an economic rent. The old peasant holdings inherit in their buildings and equipment, the results of the gradual unpaid labour of many generations and when the holding is sold this accumulated capital is counted cheap, because the price is based upon the farm's earning capacity, not upon what it would cost to reproduce it: hence the prime economic difficulty of building up small holdings *de novo*. The second question is whether small holdings can persist on any large scale under modern conditions. Depending on the basis of the occupier giving his labour cheaply as measured in terms of hours and wage rates, the total cash returns from a small holding are often little or no better than the wages of the agricultural labourer and still less than those of the industrial worker. A certain number of men are always prepared to give this price for their independence and for the chance of getting on, and upon this fact depends the social value, even the necessity, of small holdings. But it cannot be expected that a whole class of the community will permanently consent to lower wages and longer hours. Looking back at the history of British farming the merger of the smaller into the larger farms had always been going on. In other countries peasant farming had persisted longer because of the slower development of the industries, though even in France the peasant was being attracted from the land, and in the U.S. the younger generation looked askance at continuing the family farm. It was in China, Japan and India that the sheer pressure of population maintained the one man farmer at a standard of living barely above the starvation level. Some small holdings are a necessity as a social safety valve; but a general return to small holdings would not solve the problem of increased food production. Farming is an industry like any other and a return to small holdings would be as much a retrograde step as would be a return to hand weaving. Nor is the argument valid that the state would gain by having more men employed upon the land. If extra men are employed on the land because the production has been intensified there is a gain, but if the extra labour has only to make up for an inefficient method there is loss. To prohibit machinery and return to spade labour would ensure the greatest number of men upon the land but the community would lose thereby. That community is the richer which employs the smaller proportion of persons in the production of its necessary food, leaving thereby

a greater number free for the production of clothes, houses, etc., and other elements constituting wealth.

**Industrialized Farming.**—It is obvious that on the large farm very considerable economies of working can be effected, especially from the use of machinery. The cheapening of costs of production depends upon making manual labour more effective. Modern power cultivators are likely to be large in order to secure that speed and depth of working proper to their work; they therefore require large fields to save turning about and only broad acres defray their heavy overhead cost. Farming is no exception to other industries in that large-scale working by its powers of organization and concentration of effort can obtain better work done at a lower cost. The improvement of livestock by breeding and selection is only possible with numbers upon which to work. Buying and selling is better done on a large scale, however much the small holder may be able to obviate his weakness by co-operation. Large-scale enterprise can employ those methods of costing and recording upon which good management is based. In his technical methods the small holder must work by tradition; he cannot afford to experiment and is therefore slower to accept new ideas. Furthermore the land still requires considerable capital expenditure if it is to be put to its best use; and drainage, the straightening of boundaries, and similar wholesale improvements are not practicable except on a large tract of land. It seems inevitable that as intensified production becomes imperative to provide food for a growing population it can only be obtained by large-scale industrialized working. Two conditions, however, must be fulfilled before large-scale farming can be attempted with confidence. First of all a new art of management must be evolved, based upon systematic cost accounting and a critical knowledge of average standard costs. Good farming has hitherto been very much a personal affair depending upon the experience, intuition and determination of the individual. Industrialized farming will always require the qualities of the old farmer—his eye and energy; but it also calls for more calculated management even though farming cannot be standardized like other industries. The other condition of success is the formation of a corps of workers trained for their job and rewarded accordingly. The old type of agricultural labourer was a highly skilled man; much of the work of farming is now being done by men who have been prevented by some defect from entering other walks of life, or by youths who have been left to learn their craft haphazard. Efficiency demands efficient men, for however much machinery may be employed a farm cannot be supervised like a factory. But if the future of agricultural production lies with industrial farming, a bigger unit will be required than the present average British holding. Successful as was the farm of 200–500 ac. as a first step toward intensive production, it has become an uneconomic unit today; it is too small to take full advantage of machinery, is still retail in its buying and selling and demands too large a proportion of its turnover for management. With an average ratio of six labourers to one farmer on English farms, the business is insufficient adequately to pay one man solely engaged in management, and even units of 500 ac. are not large enough. The proper unit is probably something of the order of 5,000 ac., with some hierarchy of managers and under managers into which young men who have been trained for the work could enter in subordinate positions. But it is also one of the handicaps of the present system of British farming that its management is too rarely recruited from school or college as other businesses are. The possession of capital is more often the condition of entry and too often is regarded as dispensing with the need for any technical training; but the industry would be the gainer from a greater leaven of men who began on a more educated plane.

**World Agriculture.**—The depression under which agriculture laboured between World Wars I and II would seem to offer little chance of a reorganization of the industry along industrial lines, there being nothing to tempt the large capitalists to take up food production. This depression was felt in all countries and, as the Economic conference at Geneva in 1927 indicated, it was the outcome of the deficient purchasing power of Europe and of China due to industrial depression. It was perhaps initiated by the deflation policy of the leading states, because it was evident that the low prices were not due to overproduction in the usual sense of the word.

If we exclude from consideration Asia and tropical Africa, as being both self-contained in the matter of food, the population of the rest of the world, constituting roughly the countries inhabited by the white races of mankind, increased between 1913 and 1926 by approximately 50,000,000, or 7½%. The corresponding increase in the area of cultivated land was susceptible of even less accurate estimation, but according to the best figures available was about 36,000,000 hectares. Meantime, however, agriculture was not intensified, rather the reverse, and on the basis of current farming one hectare of land (2¼ ac) was required to produce the food and other agricultural materials consumed by one unit of population. On this showing the increased food production since 1913 had not kept pace with the growth of population. Considering again the countries making returns to the International Institute of Agriculture, the wheat acreage increased in the same period from 109,000,000 to 119,000,000 hectares, the production from 1,029,000,000 to 1,139,000,000 quintals, *i.e.*, nearly 11%. But part of this increase in wheat was purchased at the cost of other crops. In the countries other than Asia and Africa the four chief cereals for human consumption, wheat, rye, barley and maize, taken together, only increased in area by 4% and in production by 5%. Food animals increased, cattle by 12%, sheep by 2%, while pigs declined by 4%, from which an increase of 8% in the meat production may be estimated. These figures lead to the conclusion that latterly the expansion of world food production had not been keeping pace with the growth of world population, even taking account of the relative checks imposed by World Wars I and II and by their consequences The low prices result from the deficient purchasing power of the larger population and from the fact that the greater part of the food production of the world is carried on by peasant farmers. This method of farming can neither alter its production in response to a lower demand nor combine to maintain prices. The men who are engaged in it accept the bad times because in the main no alternative is open to them, and by their capacity to endure hardships and yet persist in production at the low prices prevailing, they ruin the capitalist farmers who have to pay wages. But there are signs that the indifferent returns of peasant farming as compared with wage earning in the industries is beginning to tell in the withdrawal of men from the land. It is clearly happening in the United States and in France, where may be seen in progress the movement that characterized England in the latter part of the 18th century. Peasant farming does not persist when industry and commerce come near and display their openings to the farmer. Moreover the opportunities for creating new peasant communities of farmers have become smaller; great stretches of unoccupied fertile land in temperate climates, such as were settled in the 19th century and provided food for the then unprecedented growth of population, have diminished. The demand for food and other raw materials produced from the land must soon be felt by the still growing population, and any return of industrial prosperity is likely to be followed by a sudden upward rush of prices because there is no margin of overproduction and accumulated stocks behind the present low prices. Production adequate to meet the real needs of the existing population cannot be met by extending the cultivated area but will require an intensification of farming on the land now available. Intensification will only be prompted by better prices and will then best be realized by large-scale farming on industrial lines. (A. D. H.; E. E. Es.)

**World War II.**—The heroic achievements of British agriculture during World War II will long be chronicled. The starting point was a general plan drafted in 1936–37. The basic objective was the production at home of as much as possible of the foods most needed in wartime. The chief means was the plowing of as much grassland as quickly as possible for sowing and planting. An acre of permanent grass feeds only one or two persons, but an acre sown to wheat feeds 20 and an acre planted with potatoes feeds 40. In May 1939 the ministry of agriculture offered farmers a grant of £2 per acre toward the cost of plowing up land that

had been down to grass for seven years or more. Steps were also taken to build a reserve of tractors By the time the war came, 350.000 extra acres had been plowed for planting.

Although the over-all war plan for agriculture was drafted and directed from London, its execution was carefully decentralized On the day preceding the declaration of war, the minister of agriculture appointed county war agricultural executive committees consisting of 8 to 12 local agriculturists for each of the 62 administrative counties of England and Wales The chairmen were carefully selected for their knowledge of local agricultural conditions and practices, their quality of leadership, and the confidence they would receive locally Appointment made the committee personnel responsible to the minister and not dependent on local votes Yet the fact that they were representative of the landowners, farmers and labourers enabled them to work with all the elements of their countrysides in a democratic way Each committee ultimately had a paid executive officer with technical assistants drawn in part from the agricultural education establishments which were closed in 1940. The committees retained the powers delegated to them by the minister but designated subcommittees on cultivation, labour, machinery, land drainage, livestock, horticulture, technical development, feeding stuffs, insects and pests, finance, goods and services, and war damage which supervised the day-to-day work. The county committees also set up 478 district committees. The main reliance was on informal advice and instruction in securing fulfilment of cropping programs, but compulsion after approval by the minister was resorted to in some 3,000 cases where the farmers refused to meet the efficiency standards set by the committees The Agricultural Improvement council, appointed in 1941, was responsible for seeing that the results of research were incorporated in farming practice as quickly as possible.

In 1941 the county committees conducted a national farm survey to ascertain the exact status of British farming and thus provide a factual basis for knowing how far the general standard of farming could be raised. Practically every farm in Great Britain was visited, and the details concerning its condition, management, equipment, capitalization and efficiency were tabulated A census of all farm stock and crops was taken, and a plan of every farm made. The farmers were classified A, B and C—good, second rate and bad, and concerted steps were taken to improve all three categories. This modern Domesday survey not only provided invaluable data for the wartime mobilization of the nation's resources but supplied a blueprint for postwar agricultural planning.

The problem of labour supply was met in a number of ways. The great and necessary increase in arable acreage called for more labour, and yet some 98.000 men left the land to enlist during the war. Provision was made for a Women's land army on June 1, 1939, and some 5,000 volunteers were accepted before the war came. The age limit was set at 17 to 40. The applicants also had to pass a medical examination and give evidence in an interview of their aptitude for farm work. The women were given a month's training at agricultural centres or on approved farms. Their minimum weekly wage was set at 45*s*. Part-time volunteers were also organized; school boys and girls and young students, office and factory workers and retired folk served on this basis Soldiers, including many from overseas, also aided at harvest time. In all possibly 150,000 volunteers helped with the harvest of 1942. In some 50 communities voluntary land clubs consisting of persons who gave their weekends and after hours to farm work were organized. Early in the war the government decided that men must not be allowed to leave the farms for the higher wages of industry, and farm wages were set at a national minimum of 48*s*. and later 60*s*. per week.

Due to war necessity Great Britain became the greatest user of farm machinery of any country in Europe. The number of tractors rose from 52.000 before the war to some 175,000 in 1944. The implement units drawn by tractors increased from 200.000 to 1,175,000. Although combine harvesters had been little used before the war because of the moisture problem, their number rose from 150 in 1939 to 1,500 in 1942. In counties with a scarcity of machinery, implements depots were organized; in others the farmers pooled their machinery in order that their maximum use could be effected The business of firms that contracted to do plowing and similar work expanded greatly. To popularize new machines, demonstrations were held

Many new machines were introduced An Agricultural Machinery Development board was set up to guide this rapid mechanization It consisted of implement manufactures, progressive farmers, representatives of the farm workers and associations for agricultural and industrial research It tested machinery, promoted standardization, provided educational and advisory services encouraged new inventions and ideas, and generally acted as the link between research workers and practical farmers. A national Institute of Engineering functioned under the board. Although large consignments of machinery came from overseas, more than two-thirds of the new units were supplied by home manufacturers.

To meet the food needs much land was reclaimed for agriculture. As the limitations were the scarcity of labour and machinery, it was necessary to take the most promising lands first The ditches on farms were cleaned and many neglected acres reworked. Golf courses, private parks, building sites, bare downs, commons and moors were plowed and planted Bogs and swamps took more expenditure, and it soon became necessary to have the many schemes of reclamation submitted to the government for approval. If approved the government bore half the cost. Inspired by the experimental work of Sir George Stapledon, many pastures of poor quality and rough grazings were reseeded, thus greatly increasing the pasturage for livestock.

As a result of the war effort Great Britain came to produce about two-thirds of the food it consumed whereas before the amount had been barely one-third. It is true that the consumption of some commodities was reduced, but on the other hand the increase was achieved in spite of the loss of more than 7.000,000 tons a year of imported feeding stuffs formerly processed into milk, meat and eggs. This represents an increase of about 70% in the net output of Great Britain's soil. The net arable acreage was increased from 12.000,000 to 19,000,000, the largest total since the early 1870s.

Despite the loss of more than 5 000,000 acres of pasture and most of the feed formerly imported, the dairy farmers broke all previous records and met the demand for fresh milk which came as a result of the National Milk scheme which guaranteed all children under five years, expectant mothers and invalids a pint a day at half price. The flax acreage was increased from 1,600 to 51,000 acres, and in Ulster the acreage was trebled. The production of sugar from sugar beets was sufficient to meet the home ration, though not the manufacturing needs. The wheat and potato acreages were doubled, and the increases in oats and barley were only slightly less. The annual production of vegetables was increased from 2.500,000 to about 400,000.000 tons. The number of sheep declined 20%, pigs more than 50% and poultry about 20%. The number of allotments and gardens in back yards were greatly increased. More than 6,000,000 families raised at least some of their own vegetables and 1,000.000 their own eggs. Although the disastrous weather conditions during the harvest of 1946 and the winter following brought deep gloom to the British countryside, it was hoped that the lessons of its wartime experience and achievement could be salvaged for the future.

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## AGRICULTURE IN THE UNITED STATES

In the Americas the white man's agricultural endeavours extend back only to the middle of the 16th century, but the agricultural achievements of the natives, whom the white man for the most part thrust aside, date back to many centuries earlier. The early Europeans may have willed that the agriculture of the newly discovered continents was to be a projection of that of their homelands, but necessity compelled them to adopt native crops and methods to sustain their colonies It was the union of American Indian and European agriculture that provided the essential basis for the ultimate agricultural development of the new world

Although the pre-Columbian agriculture of the Americas was deficient in certain fundamental respects, it had many contributions to make to the civilization which the Europeans carried around the world. The agriculture of the old world consisted of both cereals and animal husbandry, whereas that of the new world centred about a group of cereals known as maize (corn) and lacked animal husbandry of significance. Neither cattle, horses, sheep nor swine were known in the new world before the coming of the white man. The natives knew that animals could be tamed, but they had failed to propagate them for their flesh or for use as traction power. The new world also lacked the wheel and its common applications in the cart, the pottery wheel and the rotating hand mill. Instead of a plow, the new world used the digging stick and its specialized form, the spade or foot plow. On the other hand, the number of economic plants domesticated by the natives and adopted by the white man for world-wide use is extensive; the more important include maize, tobacco, potatoes, beans, peanuts, squashes, cassava, tomatoes and pineapples—a list that the old world could scarcely rival. The fact that the intruding Europeans found no wild plants of outstanding economic importance not previously utilized by the natives is evidence of their thoroughness in this field of endeavour.

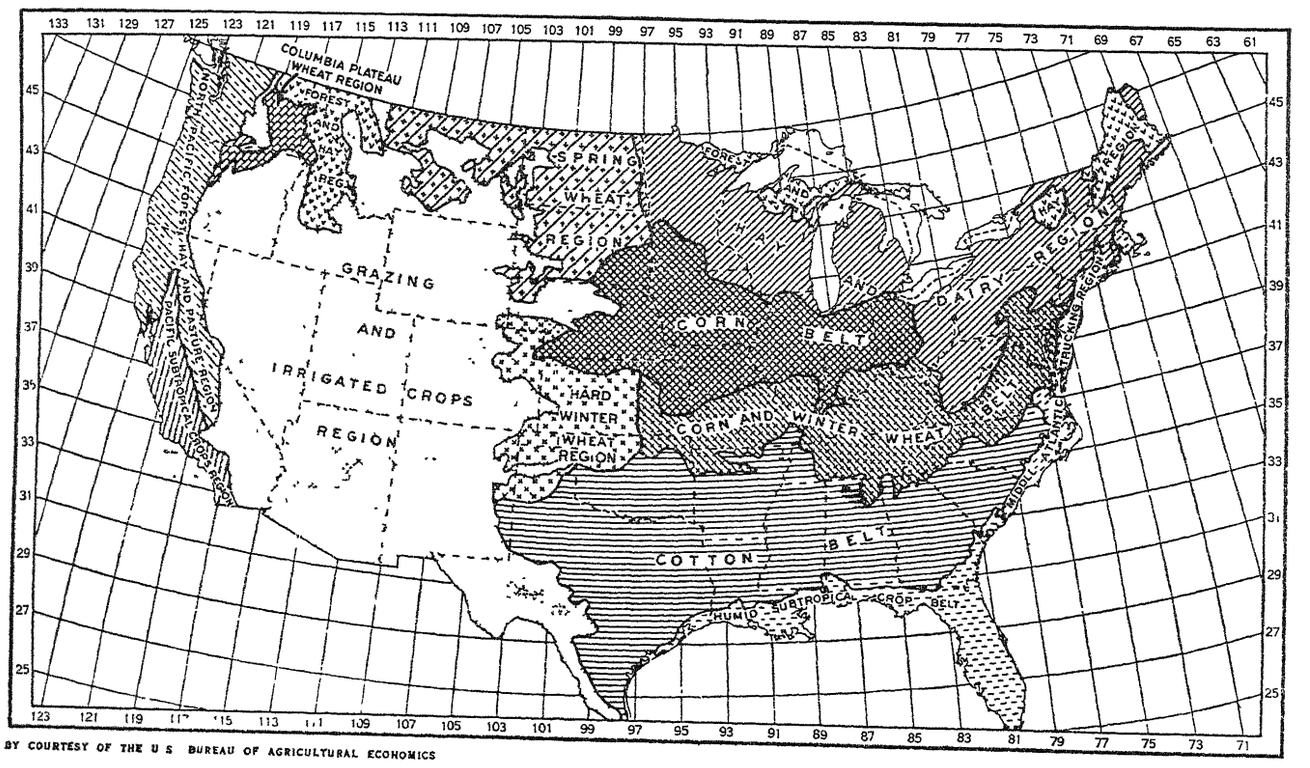
So far as the agriculture of the Thirteen Colonies is concerned, the European background is primarily England of the years 1580–1660. The mother country was then predominantly rural in its way of life. The statement of William Bradford that the Pilgrims were "used to a plaine countrie life and ye inocente trade of husbandrey" serves as a description of the English colonists generally. England of the 17th century was comparatively undeveloped agriculturally. Its great agricultural achievements came long after the founding and acquisition of the Thirteen Colonies.

The earliest efforts of the pioneering colonists to derive a livelihood from the soil can hardly be called agriculture. In general their activities resembled those of primitive tribes in the hunting and collecting stage of development. All of the initial settlements were to a considerable extent dependent on the native plants and wild animals for food until they could ascertain by trial and error what their lands could produce agriculturally.

The natural food resources of the Atlantic coastal plain where the English planted or acquired the Thirteen Colonies varied somewhat according to the latitude, but there was usually an abundance. Berries of various kinds, including blackberries, raspberries, huckleberries, gooseberries, strawberries, cranberries, and fruits such as wild cherries, grapes and crab apples, as well as nuts and certain edible roots were available in season. There was also plenty of fish, oysters and clams, and wild game such as geese, ducks, pigeons, partridges and turkeys, as well as deer. Yet the early colonists were often on the verge of starvation. This suffering amidst what appears to have been abundance has been variously explained, but basically it was because the first settlers found it difficult to revert to a different stage of living; furthermore, it was difficult to transpose and adapt the agriculture of the old world to conditions in the new.

**Colonial Land Policies.**—In 17th century England, landownership was the key to political, economic and social privilege and prestige. It was natural, therefore, that much stress should be placed on landownership in the English colonies. The early explorers had taken possession of practically the entire continent in the name of the king and thus provided him with a vast domain to dispose of as he wished.

Although the ways by which land passed from the king to actual farmers were many and varied, three distinct procedures stand out, namely the manorial system, the New England system and




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FIG. 5.—AGRICULTURAL REGIONS OF THE UNITED STATES

the southern system of headrights.

The attempt to recreate mediaeval manorialism in the new world, although it had long since outlived its usefulness in the old, was suggested by the sheer abundance of land. Although the king made grants of large tracts to friends with a view to their establishing landed estates, their successful development was contingent upon revenue returns from the land. Accordingly the grantees sought to collect quitrents from the actual occupants of the land, but the result was social friction which did not end until the quitrents were swept away during the American Revolution. The land available in other ways far exceeded pressing needs, and those with sufficient initiative to venture to the colonies were loathe to settle voluntarily on manorial holdings, albeit American versions.

Another distinctive procedure of land disposition was the New England system which emphasized group action and theoretically shunned the profit motive. The leading New England colonies were established by trading companies which received extensive grants of land from the crown and which served as, or evolved into, governing bodies. When a relatively old and settled community became crowded, at least according to contemporary standards, a group wishing to move into the wilderness selected representatives to look up a tract, usually contiguous to a settled community, which was deemed suitable for a new settlement. Having found what they needed, they petitioned the colonial government for permission to migrate there. The government, in turn, sent out a committee to examine the tract with reference to its suitability for settlement and to report on the qualifications of the would-be movers and especially of their leaders. If the committee's findings were favourable, the grant was made. It was usually a rectangular area approximating the traditional U.S. township in size.

The group receiving the grant became in essence a quasi corporation and proceeded over a period of years to divide the land in severalty among the settlers. Near the centre of the tract or in some other strategic location a village was laid out, the focal point being a green with the meeting house, the minister's house, a burial ground, a market place and a school. From the green extended the village streets with the house lots, which were plots of sufficient size for a dwelling and outbuildings, a dooryard, a garden and an enclosure for feeding stock. Then a large block of the grant was roughly surveyed and divided into strips which were distributed among the settlers by lot, each family receiving some of the best as well as some of the poorer land. When these "lots" had been developed into tilled fields, a comparable division of another block of the grant was made, and this process of distribution was continued until all of the land received by the original group had been brought under cultivation. The uncultivated land was used as a common pasture by the community, and one or more herdsmen were employed to watch the stock.

This plan of land distribution had important social and political consequences. It developed habits of group action and afforded a compact social life. It facilitated the ideal of a Biblical commonwealth and a Puritan theocracy. The town meeting, at which plans for land distribution were worked out and the officers who cared for the village property were chosen, was a vital factor in the evolution of democracy in America. The system provided an effective and equitable method of distributing large areas of land directly to actual farmers in amounts proportioned to their ability to use the land. It also afforded a security of title that facilitated an orderly settlement of new lands. It provided a sure protection against overlapping surveys and title disputes and made the town or colony responsible for the accuracy of the survey and title. The ease with which new land might be acquired and an independent living assured practically obviated a nonlandholding class and necessitated co-operation among farmers.

The idea of headrights—the granting of 50 acres of unoccupied land to immigrants landing in Virginia—grew out of the view that any person who "adventured" himself to America acquired a share in the Virginia company, but in practice the system changed greatly from the original conception. It was extended to include the members of a settler's family and his household servants, then white indentured servants, and eventually even slaves. Sea captains and merchants who brought in servants or slaves also acquired and sold headrights on their importations Indentured servants received headrights on the expiration of their periods of service Eventually fraud and evasion developed in the administration of the system. Men whose business took them back and forth across the Atlantic customarily received headrights each time they landed in the southern colonies, and the sea captains even claimed rights for their sailors. Ultimately, at least three persons—a captain, a merchant and a planter—might acquire a right on the same individual.

Finally the applicants for headrights resorted to copying names from old record books and tombstones for use on the required forms, and at about the same time the secretary of the colony began to sell headrights for one to five shillings each. The Virginia council, recognizing realities, then authorized the sale of rights to 50-acre tracts for 5 shillings. This substitution, known as a treasury right, was a reversion in legal theory to the right of acquiring land under the Virginia company by the purchase of stock, the commonwealth being regarded as a lineal descendant of the company.

Having secured a headright or a treasury right, the individual located the amount of land to which he was entitled on any part of the unappropriated domain Surveys were supposed to be made by public surveyors, but as most of these officers were inexperienced deputies the possibility of error was always present.

So far as the disposition of land was concerned, the southern system left much to individual initiative. A person could select any desirable tract of unappropriated land and have it marked off by a surveyor under his direction. There was no compulsion to consider the relation of his holding to those of others, and there was ample opportunity to engross the best land, leaving the less fertile soil for the later comers. The system was suited to the needs of a society where large plantations and slave labour, fewer hostile Indians, and a favourable climate permitted the extension and scattering of settlement over the coastal lands In the hinterland the system enabled the pioneers to locate on the good lands adjacent to streams.

**Colonial Farm Equipment.**—The common tools and implements were hoes, spades, scythes, reaping hooks, shovels, carts, harrows and plows, but the supply was probably inadequate in the early settlements.

Although a basic implement, plows were scarce during the first half of the colonial period. The Plymouth colony had none for 12 years and used only hoes and mattocks for breaking the soil The Swedish colony along the Delaware likewise had few tools of any kind until it was taken over by the Dutch in 1655. On the other hand, the farms of Massachusetts Bay had 30 plows by 1636. The early settlers in William Penn's domain around Philadelphia were also relatively well supplied. The possession of a plow made the owner the plowman of his community, and his services were in demand at practically all seasons. Many communities paid bounties to farmers who bought plows and kept them in operation.

The plows of the 18th century were very heavy and awkward contrivances. The mouldboard was not constructed on scientific principles; its iron plating, intended to cut and turn the soil, was rough and uneven, causing excessive friction, and the pull on the drawbar was much greater than on that of a modern plow. It took two men, or a man and a boy, using two or three horses or four to six oxen, an entire day to plow one to two acres. A lighter type of plow was used in cultivating corn. At the close of the 18th century, experiments with improved mouldboards and cast-iron plowshares were being made.

The procedure and the implements used in harvesting, threshing and cleaning grain were comparable with those of ancient Palestine as recorded in the Bible. Wheat and sometimes other small grains were reaped with a sickle. Grass and occasionally grain were cut with a scythe. Grain cradles were introduced in the middle colonies by the middle of the 18th century but were unknown in New England until after 1800. A good reaper usually averaged three-fourths of an acre a day, but if the crop was heavy

he was unable to cut more than half an acre. A cradler could cover 2½ acres In the middle colonies, grain was threshed by treading it out with horses; in New England, the flail was used. After threshing, the grain was winnowed as in Biblical times. A few farmers were experimenting with horsepower threshing machines by 1780.

**Colonial Labour.**—The abundance of free land at the back gate of every community stimulated independence, with the result that there was practically no voluntary hiring out. In the New England and middle colonies, as in nearly all frontier settlements, the problem of a labour supply was met to some extent by community co-operation In the southern colonies, however, where staple crops were raised on large plantations, the need was greater and consequently they resorted more largely to indentured servants and slaves

There were two general forms of indentured servitude, voluntary and involuntary. Voluntary indentured servants were persons who were so anxious to start a new life in America that they were willing to sell themselves for a period of five to seven years to shipmasters or immigration brokers in payment for their passage. German settlers, and occasionally those of other nationalities, sometimes voluntarily indentured themselves in order to obtain funds to make a more advantageous beginning on the frontier when they were able and ready to set up farming for themselves. Most of these "free-willers" came during the latter part of the 17th and early 18th centuries. As a type of immigrant they were practically nonexistent by the time of the American Revolution.

The involuntary indentured-servant group consisted of debtors, criminals deported by order of English courts, and unfortunates who had been kidnapped. The vagrancy laws in England during the 17th century were extremely harsh; the free movement of labour from one parish to another was forbidden; imprisonment was the penalty for debt; and more than 300 crimes were punishable by death Many judges felt that shipping paupers, debtors, vagrants and petty criminals to the colonies was a humanitarian act. Only a few could pay their own passage, and consequently the vast majority were sold, the term of indenture ranging from seven to ten years. Eventually the demand for this type of labour became so great that professional kidnappers seized thousands, particularly in London and other seaport towns, and hurried their victims off to America. During Oliver Cromwell's ascendancy, many political prisoners also were exiled to the new world.

By the terms of their contract, indentured servants were promised food, clothing, shelter, medical aid and the right to own property. For the most part they were well treated, but there were frequent instances of brutality. Masters did not have as strong an economic motive to protect these short-term servants as they did Negro slaves, who were a lifetime investment. At the end of their period of service the redemptioners were to be provided with an outfit as defined in the contract; in the southern colonies they usually had a headright entitling them to 50 acres of free land. The initial transportation cost was fairly heavy, the servants had to be acclimated, and the death rate was high, particularly in the last half of the 17th century. They provided only a temporary and constantly fluctuating labour supply. Of the immigrants who came after the initial settlements were established, probably one-half landed as indentured servants.

Following the example of the French, and more particularly the Spaniards, the English colonies, especially New England, attempted enslavement of the native population, but with little success The first Negro slaves in the English colonies were landed by a Dutch privateer at Jamestown in 1619. From 1635 on, a small number was imported nearly every year, partly from England and New Netherlands, but mostly from the West Indies. Despite the shortage of labour, Negroes were not popular at first, and even in 1690 there were only 5,000 in the tobacco colonies. However, at the end of the 17th century the English government restricted kidnapping and attempted to check the sending of convicts to America. As a result direct slave trade with Guinea developed, and slaveholding began in earnest.

There were about 400,000 slaves in the colonies in 1760, three-fourths of them being in the southern colonies where they constituted about two-fifths of the entire population. They constituted only a small percentage of the inhabitants of North Carolina and Maryland but in South Carolina outnumbered the whites two to one.

In the early days the legal status of the Negroes was vague. The court records of 1661 speak of Negro servants or merely Negroes and never refer to them definitely as slaves. A few were described as servants for a term of years, others were conceded property rights, and some were liberated by the courts as having served their terms. Gradually the Negroes came to be considered servants for life. If well directed, they were capable of tending tobacco, rice, indigo or other staple crops, and with their labour a planter could produce staples at a profit. Yet even at the time of the American Revolution many southerners were urging the abolition of Negro slavery, and had it not been for the rising interest in sea-island cotton and the problem of the disposition of the Negroes in the Charleston district, manumission might have occurred at that time.

Slave labour was poorly adapted to the varied activities of economic life in the northern colonies. Generally speaking, their agriculture could not employ gang labour; nor were there any year-round tasks to occupy the slaves. Slavery did prove profitable, however, to Yankee merchants and shipmasters who shared the monopoly of the slave traffic with the British. New England vessels carried rum and other commodities to the slave coast of Africa and exchanged them for Negroes. This cargo in turn was taken to the plantations of the West Indies or the southern mainland colonies and exchanged for sugar and molasses or tobacco, which was then taken back to the home port. The "middle passage," that is, the trip between Africa and the West Indies, revealed slavery's gloomiest aspect.

The Negroes who had been kidnapped in the interior behind the slave coast were placed in heavy chains and packed in the holds of the ships, where they suffered during the many slow weeks of transit. It was on this sort of trade that many New England fortunes were founded.

**Colonial Crops.**—In growing their first field crops, the early colonists turned to the numerous natural clearings or openings of the Atlantic coastal plain. Many of them were probably old cornfields abandoned by the Indians, while others resulted from the Indian practice of burning underbrush as an aid in hunting. Shortly, however, the colonists had to clear land of vegetation, and this proved a formidable task. It continued to be the first step in making farms until the pioneers of the westward movement reached the prairies of western Indiana and Illinois in the early 19th century. The sunlight had to be admitted to the soil, and the obstructions to tillage, such as stumps, roots and stones had to be removed. Whatever their original conception of the task, the English settlers soon adopted the Indian method of girdling and burning trees in order to prepare land for cultivation.

Maize or Indian corn became the universal crop, owing to its advantages under pioneer conditions of cultivation. Since it was indigenous, there was always reasonable assurance of a successful crop. The manner of cultivating it fitted in with primitive methods of clearing, and therefore it was a labour-saving crop. It also yielded more food per acre than did European grains.

Probably all of the crops familiar to the colonists in their homeland were tried at some time or other. Wheat, rye, barley, oats, buckwheat and peas became important crops, in the order named.

The first attempts to raise wheat were not successful, but by 1640 it became important in New England, judging from the fact that it was then received in payment of taxes. The Connecticut valley with its fertile alluvial soil was the best grain-producing region of New England and may well be designated as the first wheat belt of America. About 1660 the wheatfields of eastern Massachusetts began to be affected by what was called the wheat blast, now recognized as black stem rust. Within a few years it had spread to the Connecticut valley. In spite of the divers explanations given by learned contemporaries, a general relationship between the presence of common barberry and the "blast" was

recognized, and legislation was enacted to encourage the eradication of the bushes Wheat also became important in the middle colonies, to such an extent, in fact, that they came to be referred to as the "bread colonies"

Rye yielded better than wheat on light sandy and gravelly soil and was especially important along the banks of the Delaware, where Swedes and Finns had attempted to found a new Sweden. Just as this particular specialization was due to a racial emphasis, so was the production of oats This grain was produced in abundance as feed for livestock, but only after the Scotch-Irish had come in considerable numbers did the colonists of English descent begin to use oats for human food.

**Colonial Livestock.**—Because the Indians had no animal husbandry, it was necessary for the European colonists to import livestock. Because of distance and the small size of the ships, there was a pitiful scarcity of livestock in some of the settlements during the early years. The losses incident to transit across the ocean were heavy, and it was difficult for the early settlers to provide forage, shelter and protection for the animals. Another factor was the amount of capital behind the particular colonizing enterprises. Plymouth, for example, was without cattle for three years and had no horses or sheep as late as 1627. The Swedish and Finnish communities along the Delaware were also without an adequate number of livestock for many years. The Massachusetts Bay colony, on the other hand, seems to have had a sufficient supply practically from the start.

Eastern North America did not have an abundant supply of indigenous nutritive forage plants, and it was some time before the early settlers realized this fundamental deficiency. Their livestock was dependent for pasturage on the forage in the open places in the woods where fires had destroyed the underbrush or where natural openings occurred. To the early settlers two native grasses, wild rye (*Elymus* sp.) and broom sedge (*Andropogon* sp.), looked promising, but it was soon discovered that although cattle could subsist on these in the summer, the hay made from them had too high a proportion of roughage to be adequate for winter feeding. Eventually the familiar forage plants of Europe and England were introduced, either consciously or accidentally, and once started they spread rapidly. The important hay and pasture plants of today—timothy, bluegrass and red and white clovers—are thus a product of the initial necessity of the livestock industry in the U S.

The need of an adequate supply of hay and pasture continued to be a pressing problem not only throughout the 17th century but during the 18th as well. The cattle were dependent on the annual grasses in the forest openings, and with the increase in numbers of stock the grasses were grazed so short that natural reseeding was prevented. The custom of burning underbrush during the fall months also tended to hold back this process, and droughts further decreased the supply of pasture and hay. As the 18th century progressed, more attention was given to what were called "artificial meadows," that is, uplands seeded with red clover, timothy and other English grasses. This movement was probably inspired by the German-settled communities in the neighbourhood of Philadelphia.

The management of livestock during colonial times, as in most pioneer periods, may be politely described as rudimentary. The problem of confining the animals to definite localities was not easy to solve. Erecting fences required considerable labour and was especially difficult in the middle and southern colonies, where the settlements were largely individual rather than community undertakings. In New England, community settlement made common pasturing possible There the fences were usually around the cultivated fields rather than the pastures and the community hired one or more herders to watch the herds. Hogs, being difficult to confine, proved very troublesome, and in consequence they were probably the subject of more legislation than anything else in agriculture during the colonial period. There was also much legislation concerning brands and earmarks.

Livestock received little shelter in the 17th century and very little more in the 18th. This was largely the current practice in the mother country at that time, and there are indications that the settlers did not immediately realize the effect of the severe American winters on livestock. Besides, the scarcity of labour made it difficult to erect barns or even sheds, and there was also the problem of a feed supply In the course of the 18th century, housing the livestock in winter became a regular practice in New England and New York, but in the colonies to the south, the livestock continued to shift for themselves as best they could There was, however, one striking exception—the thrifty German farmers of Pennsylvania kept fewer animals but stabled them during the winter and fed them well

**Agricultural Policies of the Colonial Period.**—Legislative regulation of American agricultural production began with the earliest settlements. Like the other imperial powers of the 17th and 18th centuries, England expected its colonies to furnish raw materials and serve as a market for the mother country's finished products. Particularly was Britain anxious to stimulate colonial production of commodities for which it was then dependent on other European countries. The measures taken to foster this general policy, commonly known as mercantilism, included tariffs and rebates, subsidies, price regulation, seed distribution and even acreage control. Conforming in large measure with imperial legislation were enactments of the separate colonies seeking to stimulate or discourage the raising of certain crops.

The history of tobacco regulation is probably the most illuminating example of the methods and effects of mercantilism. In 1612 it was found that tobacco could be grown profitably in Virginia, and the colonists, stirred by the high returns, began planting it almost to the exclusion of the essential food crops. In 1616, the governor found it necessary to order each person to plant at least two acres of corn for himself and for each male servant. Tobacco growing continued to increase, however, and the acreage devoted to it was restricted again and again in order to prevent glutting the English market and to ensure an adequate food supply.

Various steps were taken between 1619 and 1652 to give Virginia and Maryland a monopoly of the tobacco market in the mother country. Planting in England was restricted, and Spanish importations were discouraged by discriminatory tariffs. The supply, however, soon exceeded the demand. Prices were depressed, and because tobacco had become the chief exchange medium for Virginia, price fixing seemed particularly desirable. In 1631-32 the Virginia assembly provided that tobacco exchanged for English goods could not be sold for less than 6*d*. per pound, under penalty of imprisonment. By 1639 production had become so excessive that a crop-curtailment and price fixing agreement was made between the colonial authorities and the principal merchants. The crops of 1639, 1640 and 1641 were to be limited to 1,200,000 lb. of good quality, and the merchants agreed to accept 40 lb. for each 100 lb. of indebtedness due them. Viewers were appointed to destroy inferior tobacco, and if necessary to burn excess crops, and in return the tobacco was to be rated at not less than 3*d*. per pound. When it became apparent that monopolization of all the colonial tobacco exports would be ruinous in view of the glutted market, re-exportation to other European countries was permitted. To temper the restriction requiring all shipments to be sent to England and then re-exported, thus subjecting them to English as well as foreign custom and excise levies, an elaborate drawback system by which part of the tariff was remitted on re-exportation was begun in 1631, and after 1723 the entire duty on the re-exported commodity was remitted.

The spread of tobacco growing from Virginia to Maryland and North Carolina aggravated the surplus problem. As a result, various intercolonial pacts were projected with a view to restricting production. More successful were the efforts at standardizing quality by a system of central warehouses and the inspection of export crops by licensed officials. These provisions were enacted in Virginia in 1730 and in Maryland in 1747. Despite all attempts at limitation, the volume of tobacco exports grew from 27,750,000 lb. in 1665 to more than 100,000,000 on the eve of the American Revolution, with a value of £900,000 in 1770. On the whole production was profitable, at least for planters who were able to employ slave labour.

Rice became a money crop before the end of the 17th century and like tobacco was subject to detailed regulation. In 1677 the proprietors of South Carolina stated that they were attempting to secure rice seed for distribution, and an act of the assembly of 1695–96 included rice as one of the commodities that might be tendered in payment of quitrents Considerable experimentation in rice planting took place between 1695 and 1715, and with a surplus available for exporting, the colonists sought the repeal of the English tariffs on rice. Portugal and the West Indies offered profitable markets, but the direct trade that resulted was contrary to the purpose of the navigation acts, and in 1704 rice was added to the list of commodities required to be sent to England and subjected to payment of duty before being re-exported. The Portuguese trade, as a result, was greatly diminished; the colonists memorialized parliament and smuggling increased. Parliament relented in 1730 to the extent of permitting direct trade to any part of Europe south of Cape Finisterre in Spain. This encouraged the rice planters to increase production. Later, however, it became apparent that the northern markets were far more important than the southern; in the decade 1730–39, for example, 74% of the rice exports went to Holland, to Hamburg and Bremen, Germany, and to Sweden and Denmark. Like tobacco, the bulk of the rice crop was then sent to England to be re-exported and through drawback provisions largely escaped British duties. In South Carolina legislative decrees attempted to establish the exchange value of rice, and there were also laws to prevent deceitful packing and to standardize the quality of exports.

To stimulate the production of indigo, instructions to accept it in payment of quitrents were sent to the South Carolina authorities in 1690, and an act passed in 1694 provided special encouragement for growing it. It was not until the 1740s, however, that the indigo industry became important. In 1734 parliament placed indigo on the free list, and a decade later the South Carolina assembly offered a bounty which was in effect for one year. Great Britain, in response to petitions from English clothiers and dyers and colonial planters, granted a premium in 1748 that was continued, although at a modified rate, until 1777. This gave the industry a tremendous impetus, and it is said that the indigo planters were able to double their capital every three or four years. England received the entire indigo crop, which before the Revolution exceeded 1,000,000 lb. a year.

Prior to 1700 Great Britain imported all its hemp and flax from the Baltic countries and Holland. To escape this dependence, a bounty of £6 per ton was placed on colonial-grown hemp, and in 1721 it was exempted from duty, and the bounty was continued for 16 years. These measures had very little effect, but after 1764 there was a revival of interest, and new bounties of £8 per ton of hemp or flax were offered from 1764 to 1771 and of £6 from 1771 to 1778. In addition to these imperial bounties, numerous subsidies were offered by the various colonies. Despite all the legislation these products never became important items of exportation.

Lumbering and the production of naval stores were essentially agricultural pursuits in the colonial period, being carried on mainly by farmers and planters. Despite the abundance of timber these industries did not develop in America until the opening of the 18th century, and then only under the stimulus of the mother country's desire in typical mercantilistic fashion to escape dependence on Baltic imports. A schedule of premiums was drawn up by parliament in 1704–05, and arrangements were made for a surveyor of woods to instruct the colonists in methods of naval stores production. In 1713 parliament further set aside £10,000 to employ skilled people and purchase the necessary tools for fostering the industry.

In all the colonies the production of tar and pitch as well as the lumbering industry were subject to considerable legislative regulation and aid. Qualitative standards were set up with penalties and officials to enforce adherence.

With the Italian Piedmont alone draining more than £200,000 in bullion from England for silk, the efforts to raise this product in the colonies were especially persistent. Numerous mulberry trees were found growing in Virginia, and silkworm eggs were imported by the Virginia company from Italy, France and Spain. The colonial assembly in its first year, 1619, supplemented these efforts by an enactment requiring each man to plant six mulberry trees annually for seven years. In 1654 Armenian silk experts were imported, and in 1656 an allowance of 4,000 lb. of tobacco was voted to one of these experts by the Virginia assembly. Bounties for production were offered in 1658, and in 1662 every landowner was ordered to plant 10 mulberry trees properly fenced and tended for every 100 acres of land he owned. As late as 1730 it was reported that 300 lb. of raw silk had been exported from Virginia. The Huguenot settlers of South Carolina were also interested in the silk industry, and acts of 1736 and 1744 offered sizable rewards for silk growing. Results were meagre, only 651 lb. of raw silk being exported from 1742 to 1755. In Georgia particularly every effort was bent toward stimulating silk production. Foreign experts were sent to the colony; a nursery of mulberry trees was established at Savannah, and four public filatures—establishments for reeling silk—were erected; books and free instruction were provided; and each grantee of a 500-acre tract had to plant at least 2,000 white mulberry trees. In 1740 membership in the newly established assembly was made conditional upon the planting of 100 mulberry trees, and after 1753 no one was to be admitted who did not annually produce 15 lb. of silk and conform to the law requiring a certain number of female slaves to be sent to Savannah for instruction in the silk industry. The high point in Georgian silk exports was reached in 1766–67, when 1,084 lb. were shipped out; by 1772–73 the figure had declined to 485 lb.

Attempts to grow silk were not confined to the southern colonies; similar visionary hopes were entertained in the north. Mulberry trees were common, and many families succeeded in actually producing some silk.

**Colonial Heritages.**—Despite the wide diversity in the geographical settings of the Thirteen Colonies, two generalizations may be made for the colonial period. The social and economic structure of all the colonies was predominantly agricultural, and the small-scale farmer of the period embodied the habits of action and attitudes of mind which were long characteristic of the American people as a national group.

In New England of the 18th century, where commerce and industry were most developed, at least nine-tenths of the population were engaged in farming. In the other colonies the proportion was even larger. The economic life of the southern colonies came to be based on large holdings of land, slave labour and surpluses of exportable staples; the plantation system determined their economies, and the planters dominated their colonial governments. Yet the small farmers with their self-sufficing holdings far outnumbered the dominating group.

It was these small-scale farmers who epitomized American characteristics. They were jacks-of-all-trades; at some time or other and often within a single year, they engaged in hunting, trapping, farming, fishing and even went to sea. They turned to any of the various rudimentary occupations as occasion required. The result was a general facility at tasks rather than the thoroughness of specialization. It was this versatility which served the American people so well as they developed the new horizontal and vertical frontiers that ultimately crossed a vast continent.

These typical colonial farmers, like their descendants, were preoccupied with the practicalities of existence and developed a self-reliance that amounted to intense individualism. The lack of opportunities to travel—either in the physical or intellectual sense—also bred provincialism. The colonial farmers were generally optimistic. With a nondescript past and a humdrum present, they looked to a future that was unhampered by realities. Through the exigencies of their economic existence they came to have a profound faith in work, preferably manual, as the duty of all.

**Agriculture during the Revolutionary Period.**—The small farmers and the frontiersmen were a mountain of strength for the revolutionary cause. They resented the Proclamation of 1763, which they believed would bar further westward expansion; they opposed the prohibition of the issuance of paper money;

they sought more liberal land policies; and they had a sense of local self-sufficiency that was hostile to outside interference. Even more immediate was their resentment of the political and economic domination of the seaboard areas over the colonial governments. The planters indebted to London merchants also adhered to the patriot cause.

On the whole, agricultural life went on much as usual during the Revolution. New England, after the first year of the war, except for the occupation of Newport and a few raids along the coast, was free from invasion New York, New Jersey and Pennsylvania suffered from the depredations of both armies. This was in part compensated for by the liberal prices paid in gold by the French and British for supplies from the farmers, many of whom were only too willing to sell.

American agriculture as a whole was stimulated rather than injured by the war. Blockade runners carried Virginia tobacco to Europe, and the last two decades of the 18th century were comparatively a golden age for that crop. In 1774 production totalled 101,800,000 lb. of leaf tobacco; by 1790 the figure had risen to 130,000,000, with one-half of the southern population engaged in or dependent on tobacco growing. Rice cultivation and export also went on with little interruption. In 1778 the first water mill for cleaning and preparing rice for market was erected on the Santee river. The cessation of imperial bounties cut the ground from under the indigo industry, but cotton came to supplant it. The legislatures of Maryland, Virginia and South Carolina encouraged cotton growing to fill local needs during the war. The same was true of wool production, which was stimulated by interference in trade caused by nonimportation agreements and the outbreak of war.

The exodus of the Tories in the course of the war permitted division of many large estates and the abolition of the last vestiges of the manorial system. As late as 1769, five-sixths of the population of Westchester county, New York, lived on manor lands. In 1777 the continental congress recommended that the colonies confiscate and sell Loyalist property and invest the proceeds in loan certificates. Little external stimulus was needed; New Hampshire appropriated 28 estates; Massachusetts seized the estates of all who sided with England; New York confiscated the 50,000-acre manor of Sir John Johnson, the Philipse manor of 300 square miles, the Morris estate, and other large holdings, which were broken up and sold in 500-acre lots; and Pennsylvania took over the property of the Penn family.

Along with confiscation and land division came the democratization of land tenure. Under the leadership of Thomas Jefferson and his adherents, quitrents were abolished; by 1786 entail, by which land was settled permanently on a person and his heirs, had been made illegal in every state but two; and the other aristocrat-fostering device, primogeniture, the exclusive right of inheritance of the first-born, disappeared by 1791 so that a farmer could hold his land in fee simple and dispose of it as he wished.

Agriculture was affected by the quickening of national consciousness that followed the triumph of the patriot cause. Practical farmers in regions where agriculture was rapidly becoming commercialized began to use gypsum on wheat fields and grasslands. Clover and other cultivated grasses also became fairly common in these regions. Although such changes had no immediate and widespread influence on agricultural production, they indicated the awakening of a new and enthusiastic interest in agricultural improvement. Washington, Jefferson, and many other prominent leaders were familiar, either by correspondence, reading or personal observation, with the revolutionary changes that were taking place in the agriculture of England, and the contrast with the generally haphazard conditions at home was a challenge. To popularize the knowledge of new methods of farming, agricultural societies which became the pioneers in the great task of agricultural education were organized.

**Land Policies to 1862.**—Having won the world-wide conflict which ended in 1763, the British were confronted with the problem of governing and settling the vast empire consisting of what became Canada and the region from the Appalachian mountains westward to the Mississippi river. The halting efforts to solve this problem ended in failure. The treaty of 1783 which recognized American independence gave the United States control of the land south of the Great Lakes and west of the Alleghenies and thus passed the problem on to the new nation. The states with colonial claims to portions of this western land were induced to cede them to the congress of the confederation which enacted the ordinances of 1785 and 1787.

The first of these laid down the basic principles of land disposition to which the United States adhered thereafter, and the second provided the principles of procedure which were generally followed in the government of all territories from the Appalachians to the Pacific ocean.

The federal land policies which developed from the ordinance of 1785 were conditioned by clashes between different schools of political thought, different sections and different economic groups. On one side were those who urged that the government should dispose of its land with prudence; in opposition were those who demanded a generous land policy. The clash of these divergent views constitutes the central theme of the history of U S. land policies during the eight decades preceding the enactment of the Homestead Act of 1862. The conflict tended to concentrate on three specific details: the minimum amount of land to be offered for sale; the price per acre; and the terms of payment.

As early as 1800 the political pressure of the frontier farmers, a group traditionally disposed to demand "liberal" land legislation, had begun to show its influence, and within 20 years their cause had definitely won. Whereas the act of 1796 had specified that the smallest amount purchasable was 640 acres, 80 acres was the minimum unit by 1820, and this in turn was reduced to 40 acres in 1832. The minimum price was reduced from $2 an acre in 1796 to $1.25 in 1820. Furthermore, in practice the minimum price tended to become the maximum price, only a few choice areas being bid for higher amounts at auction time. Thus abundance of land, plus a united public opinion, circumvented the intent of the laws.

Only in one respect was there a nominal reversal of this general trend toward a liberalization of the terms of land acquisition. In 1796 the purchaser was required to pay one-half the price in cash within 30 days and the remainder within 1 year. Four years later the credit terms were considerably liberalized—one-fourth cash, one-fourth within 40 days, one-fourth within 2 years and one-fourth within 4 years. In 1820, owing to the fact that speculators and actual settlers were in arrears amounting to $21,000,000, the credit provisions were repealed and thenceforth immediate cash payment was required.

The history of land legislation during this period also centres about three political and economic issues—graduation, pre-emption and homesteads. The first two were a result of the rapidity with which the public domain had been occupied, and they evolved logically into the third.

The frontier farmers and speculators, having before them what seemed to be an inexhaustible supply of land, selected only the better lands as they pushed westward. Gradually the existence of islands of poorer land which had no buyers became obvious and resulted in a demand to lower its price. Finally in 1854 congress passed a graduation act reducing the minimum price to $1 an acre on land that had been open to sale for 10 years and to 12½ cents on land that had been listed for 30 years.

The pre-emption issue evolved from a correlative if opposite situation. Frontiersmen, becoming impatient of or even being oblivious to the progress of the official land surveys, frequently pushed into the public domain and settled on choice locations without further formality. In doing so they were reverting to the so-called "indiscriminate location" of colonial times With reference to the land laws, these settlers—usually referred to as squatters—were criminals. When the first townships in Ohio were surveyed there were already a considerable number of settlers in the region, and attempts were made to dislodge them with militia. The frontier attitude ultimately prevailed to a large extent. The pioneers banded together into claims associations which maintained a list of each member's holdings; they selected a bidder to

speak for them at the land auctions and attended the sales as a body pledged to ensure the purchase at the minimum price of those lands which were already occupied. Again and again congress passed laws sanctioning the action of particular groups; and ultimately, in 1841, it enacted the pre-emption law by which heads of families, men over 21 and widows were allowed to settle on 160 acres of unsurveyed public land with the right to purchase their holdings at the minimum price when the land was actually placed on sale.

The Pre-emption act of 1841 and the Graduation act of 1854 were, however, merely preludes to the complete triumph of the advocates of a liberal [illegible] in 1862, when the homestead principle was enacted into law.

The general idea of free grants of land to actual settlers went far back into colonial times. The headright system of land disposition as practised in the southern colonies embodied the essential features of the homestead principle. Insofar as the quitrent system was unenforceable, it also resulted in actual settlers acquiring land. There was the further precedent of gifts of land to individuals or groups, sometimes as a reward for services rendered to the national welfare or for services anticipated. In all these three procedures settlers got land without money payments

In spite of these colonial precedents, congress was slow to abandon the conservative and conserving policies adopted during the two decades immediately following the American Revolution. Many regarded public land as a great national resource which should be administered carefully and prudently with a view toward ensuring an income to be used for the well-being of the American people. Many, notably the landowners and manufacturers of the eastern seaboard, opposed liberalization of the land policy. They saw the value of their real estate undermined by the cheaper and newer lands in the west; they also saw western land competing for their labour supply and thus compelling higher wages. The opposition soon rationalized this self-interest and found itself expounding the view that government generosity with land paupe[illegible] and encouraged laziness. Even as late as 1832 the western leader, Henry Clay, opposed any reduction in the price of public land.

In contrast, the self-interest of the pioneer farmers and land speculators in the west generated a notable enthusiasm for cheap and ultimately free land. To secure effective action, they joined forces with city workers who hoped to escape westward and benefit thereby. In the 1840s the National Reform association took the leadership, propounding the doctrine that the public land should be distributed in equal amounts to actual settlers. One of its most effective pamphlets was entitled "Vote Yourself a Farm," and much emphasis was placed on the idea that land ownership was an essential ingredient of the political philosophy to which the United States was dedicated.

At its best the cause of the liberal land policy which came to be epitomized in the idea of free homesteads of actual settlers transcended mere economic self-interest. Many contended that land sold on liberal terms or even given away promoted true democracy. Perhaps the most eloquent spokesman of this view was Senator Thomas Hart Benton of Missouri. It is certain that beneath the passing arguments of the politicians and the pamphleteers lay the conviction that equality of economic power was essential if genuine freedom and democracy were to thrive in the U.S.

The homestead bill introduced by Andrew Johnson passed the house of representatives in 1852, but complete enactment was destined to be held up for a decade because it became a part of the slavery controversy In the first vote a majority of the southern congressmen supported the bill, but as sectional tension intensified they veered away, and final passage awaited the withdrawal of the southern representation from congress after secession.

**Agricultural Settlement, 1776–1850.**—At the beginning of the struggle for independence the colonies had a population of 2,750,000 In 1790, when the first census was taken, there were approximately 4,000,000 people of the United States. Of these, 94% inhabited the Thirteen Original States; only 250,000 had settled in the west of that day—principally in Vermont, Kentucky, Tennessee and Ohio By 1850 the nation consisted of 31 states and a population of more than 23,000,000. The frontier line had leaped the Mississippi river northward into Minnesota and Iowa, and southward into Texas; skipping the Great Plains, it had followed the trail of gold into California. All this had been effected in one lifetime.

The migration, one of the greatest in world history, streamed across the Atlantic and swelled through the settled regions of the east. More than 2,000,000 immigrants swarmed in from 1820 to 1850, and in the next ten years 2,600,000 more arrived. Land was the great magnet. Rich virgin soil, seemingly unlimited in extent and available almost for the asking—such was the common theme repeated by shipping agents and in letters, pamphlets, newspapers and handbills. It was an irresistible temptation to farmers sweating over worn-out lands and to city folk who were restless, adventurous or unsuccessful.

**Agriculture in the Old Northwest.**—Until the prairies of western Indiana and Illinois were reached, the farming in pioneer communities west of the Alleghenies was essentially a repetition of the experience along the Atlantic seaboard during the two centuries of the colonial period. The frontiersman cleared from one to three acres by girdling and grubbing and then planted the field to vegetables and corn. At this stage the family depended on game and other wild products to supplement the food raised Maple sugar was also important, but potash was the only cash product. With more land cleared, additional corn and some wheat were added. Gradually a farm capable of producing surpluses for outside markets was developed.

The responsiveness of wheat to new lands is patent to students of agricultural tendencies, and its development in the region northwest of the Ohio river is an excellent illustration. New York and Pennsylvania were the leading wheat-producing states during the first quarter of the 19th century; but during that time there was a westward shift even within their borders, the Genesee country supplanting the Hudson-Mohawk valley. Ohio became an important producer of wheat during the '30s, but the big shift westward came during the '50s. Whereas Pennsylvania, Ohio and New York—in the order named—had been the top-ranking states in 1849, Illinois, Indiana and Wisconsin took their places within a decade. In that time Wisconsin rose from ninth place to third, and New York and Pennsylvania experienced not only a relative but an absolute decline. By 1860 the five states of the old northwest were supplying about half of the wheat produced in the entire United States. Within the region, the hilly counties of Ohio and the prairies and oak openings of Indiana, Michigan, Illinois and Wisconsin were the areas of concentration.

When the pioneering farmers reached the edge of the prairies in Indiana and Illinois, they hesitated, believing that land which did not support trees was not rich enough to produce farm crops. The lack of a ready supply of wood for buildings, fences and fuel was also a factor. The dependence of these frontiersmen on the rivers as avenues of transport to markets and the scarcity of water and lack of shelter for livestock on the prairies also made them reluctant. The thick and heavily matted prairie sod was a formidable challenge to the customary wooden and cast-iron plows, and from three to seven yoke of oxen were required to break new fields. Even then it was two or three seasons before the grass roots had rotted sufficiently so that the fields could be worked easily. Higher prices for grains after 1845, reflecting conditions in Europe, together with the coming of the railroads, affected the occupation of the prairies. The challenge of the sod led to the development of the steel plow and eventually, after experiments with various fencing materials such as sod walls, smooth wire and Osage hedges, the fence problem was solved by the invention and perfection of barbed wire.

Corn production, like that of wheat, responded, though less quickly, to the pull of the new lands in the old northwest. In general it tended to occupy a belt directly south of the wheat region, but prior to the end of the '60s a corn belt was not clearly delimited except for special areas, such as the rich bottom lands along the Scioto river and the limestone basins of Kentucky and

Tennessee. The census of 1840 revealed Kentucky, Tennessee and Virginia as the leading corn states, but within two decades the centre of concentration had shifted northwestward to Illinois, Ohio, Missouri and Indiana, with Kentucky and Tennessee in fifth and sixth places. By this time Iowa and the eastern parts of Kansas and Nebraska had become important centres. The older states in the east continued to produce corn for their own needs

The corn of this northwestward-moving belt was marketed in the form of whisky and hogs, the first because it was valuable in proportion to bulk and the second because hogs furnished their own motive power. The hogs of the frontier were a special type, essentially a product of the rigours of life in the open and were known aptly as "wind-splitters" or razorbacks. Many pioneers raised several hundred hogs a year. If they were left to feed on the forest mast alone, they put on flesh that was soft and difficult to preserve They also became untractable and lacked the stamina to survive the rigours of severe winters It was therefore essential to supplement the mast with corn, and eventually, as markets developed, corn-feeding and marketing hogs became the basic activities of agriculture in the old northwest.

In the early 19th century the hogs were taken down the rivers on boats to be sold to the plantations in the south or driven overland to eastern markets. At first the farmers drove their own hogs eastward, but gradually a profession of drovers developed and the trade became standardized. Some herds numbered as many as 5,000 and moved eastward at the rate of 8 or 10 miles a day. Although the ultimate destination was usually Philadelphia, Pa., Baltimore, Md., or New York, many herds were taken to the plantations of Tennessee, Virginia and the Carolinas. This method of marketing declined with the development of meat packing along the Ohio, especially centring about Cincinnati, which became known as "Porkopolis." The coming of the railroads was a final factor ending this trade.

The range-cattle industry has always been associated with the frontier, and the region north of the Ohio river was no exception. As early as 1805 George and Felix Renick of Ohio drove a herd of range cattle overland to Baltimore, where they cleared a profit of more than $30 a head. Their success led to other similar drives, and shortly the marketing of range cattle in the east became a well-defined source of cash income for the farmers in the west of that time. The drives were started in the early spring and continued through the summer. Each night the herds were halted at "drove stands," where food and shelter were provided for both the drovers and their charges. Four-year-old steers were driven slowly and sold directly to the abattoirs. Three-year-olds were often sold to the farmers in the hinterland of Philadelphia for feeding. By 1840 the farmers of the Ohio valley had taken over the fattening of their own cattle, and this development became specialized in a zone bounded on the south by the 36° parallel and on the north by the 40° parallel. The bluegrass region of Kentucky and the Scioto valley were the centres for corn feeding, and many of the leaders in this development were former Virginians who had known of similar methods on the banks of the Potomac in the days of Washington.

Eventually these feeders reached out for additional stock from the prairies of Illinois, Iowa and Missouri and from the wheat farmers to the northward. Before large-scale refrigeration, it was difficult to preserve beef in a palatable form, and beef packing did not develop on a scale comparable with that of pork. The eastern cattle drives, therefore, continued long after the hog drives had ceased. The advent of railroads after 1850 brought an end to the drives, and the cattle-feeding industry pushed westward to the corn belt.

**Eastern Agriculture and Western Competition, 1775–1860.**—In the New England and middle Atlantic states the colonial pattern of agriculture continued dominant until the second decade of the 19th century. Cultivation was extensive and exploitive, tools clumsy, systematic crop rotation and fertilizers generally absent, livestock neglected and orchards and woodlands badly managed. Each farm was a self-sufficing unit, growing food for home needs and a scant surplus to be exchanged at the local store for salt and sugar. For the most part tools and clothing were made in the farm home. In New England wheat had been generally abandoned, except in a few favoured regions, and root crops such as potatoes and turnips were noticeably lacking. The prevailing mode of crop rotation was the mediaeval practice of alternating grain, grass and fallow. Implements were few in number, most farmers being able to carry all they possessed on their backs, and the plows were home-made wooden contrivances with a plating of iron strips added by the local blacksmith Oxen were the chief draught animals, and cattle generally were noted more for their hardiness than for beef or dairy production A fundamental cause of this retardation was the [illegible] sets for surplus production.

There were exceptions to the prevailing agricultural backwardness. Between 1801 and 1811 [illegible] were imported from Spain, and the result was a vast improvement in U.S. flocks. Pennsylvania as late as 1840 was the leading wheat-producing state, and considerable grain was also raised in the Hudson-Mohawk valley of New York; the middle states were to a considerable extent the bread states for New England and the south Corn was a leading staple in New England, the output per acre averaging 25 to 30 bushels; in the Connecticut valley, it occasionally averaged as high as 40 or 50 bushels. The Connecticut valley in general was a prosperous farming country still able to raise wheat commercially, and its more progressive farmers used gypsum to restore the soil.

Other outstanding areas were the Narragansett country of Rhode Island, where dairying for exportation was extensive, and the western counties of Massachusetts, which produced grain commercially.

When the rise of manufacturing resulted in the concentration of a large nonagricultural population in towns and cities, a spirit of commercialization became evident in northern agriculture. This change began after 1810; the population of the eastern states increased from 3,487,000 in that year to 6,761,000 in 1840; urban centres of more than 8,000 inhabitants increased from 3 in 1790 to 33 in 1840; while in southern New England all but 50 of the 479 townships had at least one manufacturing village clustering around a textile mill, an iron furnace or some other industry. To meet the demand of this new market the farmer turned to lighter and better-designed agricultural tools; the grain cradle displaced the sickle, the iron and later the steel plow superseded the wooden plow, and the cultivator supplanted the hand hoe. Improved machinery brought increased production and decreased labour time and costs. In Pennsylvania and New York the horse replaced the slow-moving ox as the main draught animal.

Creation of a home market brought a shift from general to specialized farming, and each locality tended to concentrate on the products for which its soil, climate and geographical position were best suited. Market gardening and dairying developed in the immediate vicinity of urban centres, notably around Boston, Mass., New York, N.Y., Philadelphia, Pa., Providence and Newport, R.I. Lands were reclaimed, meadows drained, and dry lands irrigated; the soil was repaired by the planting of clover and the use of gypsum; more labour was hired; and the teachings of the new agricultural societies were heeded. One effect of these changes was a sharp rise in land values; an acre outside of Philadelphia brought $150 in 1837, and near New York land prices in some instances increased fourfold between 1800 and 1840. Tenancy also appeared as immigrants leased truck farms before purchasing their own lands. The production of fluid milk to meet town and city needs became prominent in these decades and continued to expand even after the centre of dairying had moved westward.

Feeding cattle for beef received increased attention in the east, concentrating in the Connecticut valley, which supplied the Brighton market near Boston, and in southeastern Pennsylvania. Specialization in butter and cheese making developed chiefly north of New York city and in central New York after the completion of the Erie canal. Around other cities the sale of fluid milk had largely supplanted cheese and butter production by 1840. Striking improvement was effected in swine husbandry by crossing with improved breeds, but there was no marked geographical con-

centration.

Eastern wool growing enjoyed its greatest prosperity in the decade of the 1830s. The domestic manufacture of woollen goods was firmly established, and, stimulated by protective tariffs, it increased its output and demand for raw materials. In 1837, 28,000,000 of the 38,000,000 lb of wool used in the mills were of local origin. In 1840 the eastern wool growers owned 60% of the country's sheep, but specialization was already well developed. In New England production was limited to Vermont and the hills of western Massachusetts and Connecticut.

Among other changes in northeastern agriculture that came in response to urban needs were the increase in hay production to feed the horses in city and town stables and the growing of potatoes in considerable quantities, particularly in Maine and on Long Island. Farmers also conducted a profitable business in supplying city dwellers with firewood and charcoal and furnishing sand, stone and timber for buildings.

Now that the farmer received a cash income he turned to factories for the clothes, tools and furniture he had formerly made for himself. The decline of household industries had as revolutionary an influence on rural life as the growth of industrialization had on the formation of a wage-earning class. As self-sufficient farming waned, long-established habits and traditions in thinking and living were uprooted. The family as an economic unit became less important, with all that implied for rural mores; farmers' sons and daughters began migrating to mill towns to take up a new way of life. Those who remained behind developed a taste for urban standards of living. Others were stirred to action and turned westward.

These changes did not appear overnight, and they did not affect all farmers uniformly. Ingrained habits tended to keep many farmers in the old ways of producing what they needed for their own uses, buying and selling little. Lack of working capital was another serious hindrance; the farmer marketed his produce once a year and had to maintain his family on the returns until the next year. The country store was the chief source of short-time credit, and interest rates were high because losses were frequent. Where the farmer realized a surplus, he preferred to invest in lands, in larger homes, or in outside enterprises, rather than in labour-saving machinery. Mortgages increased noticeably in number after 1830, but the money was used for paying bills or in outside speculation instead of for financing farm improvements. The imperfect organization of markets was another obstacle; the country merchant, the chief middleman for farm produce, performed his function badly and at a high cost.

While the eastern farmer was still adjusting himself to commercialized agriculture he was faced with a second transforming influence, namely, western competition. The Erie canal was opened in 1825 and brought steadily increasing quantities of foodstuffs to the eastern markets, but the pressure greatly increased after the railroads reached beyond the Alleghenies. By 1850 there were 7,000 miles of railroad in the country, largely concentrated in the northeast and northwest; and ten years later Minnesota, Iowa, Nebraska and Kansas were already pouring surpluses eastward. From the west came wool, wheat and pork in such quantities and at such low prices as to discourage local production. Sheep raising in southern New England declined nearly 50% between 1840 and 1850, with a further drop of 35% in the next decade. The products of the eastern wheat growers, suffering from soil deterioration and crop blights, could hardly compete with the products of fertile lands newly opened in the west; and by 1840 flour from western wheat was used generally in New England, not only by city folk but by farmers as well.

Before the advent of refrigerator cars the effect of competition in beef and pork production was somewhat tempered, although by 1859 half the beef supply of Massachusetts came from outside New England, and Philadelphia received 32 552 tons of livestock from Pittsburgh over the Pennsylvania railroad. Between 1840 and 1860 the number of swine in Massachusetts, Rhode Island and Connecticut fell from 306,000 to 167,000.

Serious as these inroads were, they by no means crowded out eastern production entirely. If local farmers almost completely lost the markets for wheat and wool and to a lesser extent for live cattle and hogs, the advantage of their proximity to industrial centres could not be overcome altogether. More attention was given to growing vegetables and supplying fluid milk. Cheese and buttermaking increased, and by 1860 New England and the middle Atlantic states accounted for 70% of the country's cheese and close to 50% of its butter. In New York, the nation's leading dairy state, production was centred in the Mohawk and Hudson valleys, with some expansion into the central counties; Vermont led in New England, although Litchfield county in western Connecticut was famous for the fine quality of its cheese; while southeastern Pennsylvania supplied butter and milk for the Philadelphia, Wilmington and Baltimore markets.

The New England and middle Atlantic states grew more hay and forage in 1860 than in 1850, although their share of the country's total dropped 15%. Corn production increased in New England between 1840 and 1850 but then declined; on the other hand, the crop of potatoes in Maine in 1860 was almost twice as large as that of 1850. A final example of adaptation to city needs was the increased planting of orchards. Horticultural societies were formed, improved varieties of apples planted, and old native fruit trees grafted. By 1847 Oneida county in the Mohawk valley shipped nearly 18,000 barrels of apples.

Eastern agriculture thus underwent two major changes by 1860. In response to the growth of a home market, farmers gradually shifted from self-sufficing to commercialized agriculture between 1810 and 1840. While this change was still taking place, the farmers on rich virgin soil to the westward began to ship their produce by canal and railroad to eastern markets. As a consequence, local farmers were forced to specialize in articles such as milk, butter, cheese, vegetables, fruit and hay, which, by reason of their perishability or bulk, escaped western competition and enjoyed a ready market in the expanding urban centres close by.

**Southern Agriculture to 1860.**—Despite an ever-growing rivalry with the northwest, the south continued as the principal centre of commercial agriculture from the Revolution to the American Civil War. Its pre-eminence, however, was due chiefly to the rise of cotton production and its expansion into the old southwest. Tobacco fell off greatly in relative importance. Indigo cultivation waned, having suffered a death-blow by the removal of the British bounty. Rice farming underwent a transition incident to the adoption of the tide-flow system. Hemp and flax later became crops of some importance in Kentucky and Missouri, and sugar growing achieved considerable success in Louisiana. It was cotton, though, and particularly cotton on western land, that predominated.

Cotton had been grown in the southern colonies but only for domestic use. Yet the revolution in textile manufacture in England that made possible mass production of cotton textiles for a world market created a comparable demand for the growth of cotton fibre. Soil and climate favoured the green-seed short-staple variety, but separation of the seed from the lint was difficult, slow, and expensive because the fibre had to be cut or torn away. Sea-island cotton, a longer-fibred variety, was introduced in 1786. Its seeds were easily removed by running the fibre between rollers that revolved in opposite directions. Although sea-island cotton brought high prices and was raised, often on a large scale, until the American Civil War, the acreage devoted to it was limited, as it could be successfully grown only on the lowlands along the southeastern coast.

The cotton gin invented by Eli Whitney in 1793 solved the crucial problem incident to large-scale production of the green-seed short-staple cotton, and its invention marked a turning point not only in southern agriculture but in U.S. history. Upland or short-staple cotton became the largest commercial crop in the south and the basis of its economy. Each decade cotton production approximately doubled. In 1800, 73,222 bales of cotton were produced; in 1840, 1,347,640; and in 1860, 3,841,416. It overflowed the domestic market and became the largest single export of the United States. In 1810 cotton represented 23% of the value of total exports, or a little more than $66,000,000; by July 1, 1860, it had increased to 61%, or more than $333,000,000.

As the south concentrated more and more on cotton growing, it also offered a larger market for northwestern grain and livestock products.

Cotton expansion revived the moribund institution of slavery, as the growing of cotton was very well adapted to unskilled supervised gang labour. In the five years before the federal prohibition of the slave trade became effective in 1808, South Carolina alone imported 39,000 slaves, and by 1860 its slave population increased to 57.2% of the total population. Another institution, the plantation, similarly became prominent, and the three together—cotton, slavery and the plantation—acquired a dominating influence over the political and social as well as the economic structure of the south.

Cotton growing centred first in the tidewater region of South Carolina and Georgia Many planters shifted to it from indigo and rice cultivation. The methods of cultivation were crude and wasteful, not because of slave labour but because land was abundant and cheap. Squandering natural resources was as characteristic of the southern planter as of the western pioneer Cotton growers reached out to the Piedmont of North Carolina and Virginia and then turned southwestward. The War of 1812, the acquisition of east and west Florida, and the removal of Indians to reservations beyond the Mississippi were, in part at least, due to cotton. The belt of heavy black and brown loam soils in Alabama and Mississippi were found to be unsurpassed for cotton, and this region long remained the foremost cotton district in the world. Nevertheless the migration of cotton planters continued westward into the second area of great cotton production along the lower Mississippi. Even these conquests were not enough, and the land-hungry and restless pushed on to the prairie region of Texas.

Until 1821, more than one-half of the cotton had been grown in Georgia and South Carolina. By 1850 Alabama ranked first, Georgia second, Mississippi third and South Carolina fourth. In 1860 Mississippi, Alabama and Louisiana produced more than one-half of the total cotton crop in the United States, while Texas grew more than South Carolina. In the north, when the Atlantic seaboard states could not meet the challenge of western agriculture, industrialization was intensified; in the older south no such compensating factor was present, and economically it fell steadily behind the southwest. Land values declined, and Savannah, Ga., and Charleston, S.C., were supplanted by New Orleans, La., and Mobile, Ala., as trade centres. Even by 1820 the areas first devoted to cotton presented a sorry picture of eroded lands, bare of vegetation except for scrubby growths.

The southeast blamed its decline on the tariff, the federal banking policy, the lack of credit facilities and heavy taxation. All these factors were present, but the problem was primarily accentuated by the rapid westward expansion. Despite many pamphlets, resolutions and conventions, a movement for industrial diversification did not progress far because the capital available was too closely tied up with landed investments, while the labour supply, whether slave or "poor white," needed wholesale readaptation. As an alternative, the southeast sought to establish itself as the trade centre for both the southwest and the northwest, but the former developed its own ports, and the latter became tied to the northeast by railroads.

Attempts were made to adjust and reform the agriculture of the southeast to the changed conditions. John Taylor "of Caroline", sought to halt the retardation of Virginia agriculture by improved methods of farming, and Edmund Ruffin sounded an even more clarion call to check soil depletion. When the older region first felt western competition, it found itself with too much slave labour. Transfer of that surplus westward only strengthened the competition. Finally, in the '40s and '50s, when labour was needed for agricultural diversification, slaves were scarce. The old south could not afford to pay $1,000 to $1,400 for prime hands and was outbid by the southwest, where fertile lands yielded a much greater output per unit of labour. In desperation the southeast sought a reopening of the slave trade; though the attempt failed, slave smuggling probably was increased. More important for later development was the fostering of progressive methods such as deeper plowing, the introduction of new crops, the increased use of labour-saving devices, and the importation of improved breeds of livestock Agriculture' journals and societies were begun and fairs and exhibits held. General farming became a prominent feature of the agriculture of the border states, and just prior to the outbreak of the American Civil War Virginia achieved a moderate prosperity as a result.

Tobacco, the south's chief colonial staple, reached its height in the 1790s, when more than half the population of Virginia, Maryland and North Carolina were engaged in or dependent upon its cultivation In 1790 it ranked first on the list of U.S. exports, with a value of more than $4,000,000. After 1800, however, it declined rapidly in relative importance, and production remained stable until 1850. The disturbed trade conditions resulting from the Napoleonic Wars, the post-1815 attempt of England to stimulate domestic tobacco production or West Indian importation, the high duties imposed by countries of continental Europe anxious for revenue, and the competition of Cuba, Sumatra and Colombia all helped to undermine the position of United States tobacco in the world market

At home, meanwhile, cotton was outbidding tobacco for the available land and labour. By 1850, tobacco production had passed its lowest point and had begun to revive. Flue curing supplanted the old-fashioned, charcoal-fire, open-air methods, while a new yellow-leaf variety, lighter than the old varieties, won popular favour. Between 1850 and 1860 production doubled, North Carolina and Virginia being affected most.

Tobacco, like cotton, expanded to new fields in the west in the years before 1860. Extractive pioneer cultivation laid waste the older lands, while low prices on the world market called for decreased production costs. It was cheaper to move to fresh soil than to struggle with worn-out fields. Virginia maintained its lead till 1860, but Kentucky was close behind, and Ohio, Tennessee and Missouri had made a considerable advance. Two important trade and manufacturing centres for tobacco, Louisville, Ky., and St. Louis, Mo., developed in the west.

Sugar production, like that of cotton, grew from insignificant proportions to outstrip tobacco in importance. The cane was introduced into Louisiana by Jesuits from Santo Domingo in 1751, but it was not until the last decade of the same century that the crop was grown on a commercially significant scale. The sugar district centred along the rivers and bayous of southeastern Louisiana, where the soil was rich and the growing season was sufficiently long for the plant to mature. Despite fluctuations caused by floods and occasional early frosts, production increased from approximately 20,000 short tons in 1823 to 270,000 in 1861. Unlike most other southern staples, sugar enjoyed the protection of a high tariff, and the industry was highly mechanized; sugar production expanded slowly, either to the west or to the east. It did extend over to the Brazos river area of Texas and to a lesser degree into Florida and Georgia, but in these states it was relatively insignificant. Though the industry was limited in the main to Louisiana, it affected the southeast. Many South Carolinians, for example, migrated to Louisiana, taking their labourers with them. By 1860 the sugar plantations were using a total of 180,000 slaves; this involved a considerable drain of labour from the Atlantic seaboard and sent slave prices upward.

Rice continued to be a leading agricultural crop along the coast of South Carolina and Georgia until the American Civil War. Production increased threefold from 1820 to 1850 but suffered a distinct decline in the next decade. In the banner year of 1850 South Carolina and Georgia together accounted for almost all the rice grown in the United States. There was some development of the industry in Louisiana, Mississippi and Alabama, but it was of little consequence. Rice planters felt western competition most when they had to bid for labour on a market dominated by the cotton growers of the southwest.

Almost from the first settlement of Kentucky, hemp raising was found well suited to the rich limestone areas. Unusually favourable prices from 1826 to 1828 stimulated production, and hemp growing expanded into middle Tennessee and, during the '30s into the rich valleys of Missouri. The cotton industry had a

considerable interest in hemp, since it was manufactured locally into baling cloth, rope and clothing for Negroes. In 1859 Kentucky and Missouri together produced more than three-fourths of the 57,000 tons of hemp raised in the United States. Soil deterioration, scarcity of labour and Russian competition, however, had already influenced Kentucky to turn more toward wheat growing and cattle raising

While the south raised all of the cotton, rice and sugar grown in the United States and more than 80% of the tobacco, its other crops also ranked high. It produced more than 50% of the country's corn, more than 70% of the peas and beans, 94% of the sweet potatoes, and a little less than 30% of the wheat. In producing each of the principal classes of livestock the south ranked higher per capita than the United States as a whole. Kentucky was famous for its race horses, horned cattle and Hampshire hogs, while Virginia was a leader in sheep raising. Eighty-six per cent of the south's general farming was located in the border states in 1859

In the south the landowning class was divided into gradations of small, intermediate and large farmers, and small, intermediate and large planters. In 1850 only 18% of the south's 569,000 farms and plantations were actually plantations, and this estimate includes as "plantations" many thousands of small cotton and tobacco holdings with but one or two working hands. Even in the black belt of Alabama almost 80% of the nonslaveholding landowners, who in 1850 constituted 44% of the region's agricultural population, owned farms ranging up to 200 acres. Of the slaveholding landowners, more than 50% owned 10 or fewer slaves and 500 acres of land or less, which classed them as farmers. Together the small planters and the slaveholding and nonslaveholding farmers owned approximately 75% of the landed wealth in the black belt—the so-called stronghold of the plantation system. As late as 1860 only 348,000 families out of a total of 793,493 white and free Negro families owned slaves in the south.

While the yeoman farmer was more truly characteristic of the landholding class, even in the ante-bellum south, it was the 2% holding plantations with more than 50 slaves that dominated economically, politically and socially. Not until the American Civil War overthrew this planter aristocracy did the yeoman or dirt farmer begin to come into his own.

**Agricultural Revolution.**—The transformation of U S. agriculture from a simple, pioneer, and largely self-sufficing occupation into a modern business organized on a scientific, capitalistic and commercial basis is frequently referred to as the agricultural revolution. Simultaneously industry shifted from hand labour in homes to machine production in factories, and local markets were transformed into a world market.

Like all striking changes this vast reorientation of the country's economic life did not begin suddenly or in all regions simultaneously. Even in the colonial period many American communities concentrated on the production of surplus crops for distribution in markets beyond their confines. During the latter half of the 18th century the agriculture of England underwent a similar change, and the accompanying desire to utilize improved methods in order to make farming profitable was not without influence in the United States in the years following the American Revolution. While the forces of the so-called agricultural revolution had long been at work in the United States, it was not until the last half of the 19th century that they began to manifest a fruition which captured general recognition. Careful study of the agricultural history of the United States reveals that its agricultural regions and perhaps also the country as a whole experienced a number of quickenings of agricultural progress and that it would be more accurate to speak of a congeries of agricultural revolutions rather than merely one Perhaps, indeed, the over-all agricultural revolution is the adjustment and response of agriculture generally to world opportunities and conditions that followed the so-called Europeanization of the world, a process which included the merging of the old and new world agricultures

The forces underlying the so-called agricultural revolution in the United States may be summarized as follows: The passing of the public domain into private ownership by means of liberal land policies; the completion of the westward movement of settlement; the invention and popularization of improved farm implements and machinery; the extension and development of transportation facilities; the expansion of domestic and foreign markets, the migration of industries from the farm to the factory; the resort to conscious and concerted political organization and action by farmers in an effort to retain an equitable place for agriculture in the economic structure of the nation; and the establishment of agencies for the promotion of scientific knowledge relating to agriculture—agricultural societies, agricultural fairs, periodicals for farmers, the federal department of agriculture and agricultural colleges and experiment stations. These forces, it should be emphasized, did not reach their maximum impact simultaneously, and some of them were still operating with increasing potency after World War II.

**Passing of the Public Domain.**—Under the Homestead Act of 1862, the head of a family or a person over 21 who was a United States citizen or had filed intention of becoming one received title to 160 acres of the public domain after proving five years residence, by evidencing good faith by cultivation and paying a nominal registration fee. After 6 months (raised to 14 months in 1891) the entry might be commuted by the payment of the prevailing minimum price, usually $1.25 per acre. Later amendments permitted veterans of the Union army and of succeeding wars to count the time of their military service against the five-year residence.

The homestead policy was not well adapted to much of the public domain to which it applied. By this time agricultural settlement had reached the eastern edge of the Great Plains. To the west the average rainfall ranges from 10 to 18 inches and falls much lower during seasonal and cyclical dry spells. The farming techniques developed for the humid soils to the east were unsuitable for these new conditions. Effective land utilization required dry farming, grazing or intensive cultivation with irrigation, but 160 acres was too much land for irrigated farming and too little for grazing or dry farming.

Moreover, the homestead method of distribution was merely an addition to others already authorized by previous statutes, and the result was an incongruous land system. The cash sale of land was continued to 1891, and more land was bought than homesteaded. Between 1862 and 1871, the railroads received about 125,000,000 acres as subsidies, and homesteading was not permitted except 20 to 40 miles back from the projected routes. By the Dawes Act of 1887, modified by the Burke Act of 1906 and later measures, about 100,000,000 acres of Indian lands were opened for sale. More than 7,000,000 acres were given to the states in accordance with the Land Grant College Act of 1862.

With such a vast empire of land purchasable, speculation and land monopolization became rife. Syndicates purchased land in large blocks and generally secured the most desirable lands. Actual settlers might get free lands that were less fertile or less advantageously located or buy at prices set by the speculators, the railroads or the states.

The administration of the land laws was even less satisfactory. Fraud became rampant, and the general land office which supervised disposal of the public domain did not have the organization, the personnel, or the public and official backing to ensure careful and honest administration.

Efforts were made to adapt the homestead principle to special situations. Measures were passed from time to time to aid homesteaders affected by droughts. In 1873 the Timber Culture act promised 160 acres to any homesteader who kept trees growing not more than 12 ft. apart on 40 acres, and 5 years later this minimum was lowered to 10 acres. In 1909, the size of homesteads was increased to 320 acres in portions of eight western states. A quarter of the tract was to be cultivated, and no commutation was allowed. In 1916 the maximum was increased to 640 acres for farmers who wished to raise stock.

By the Desert Land Act of 1877, 640 acres of arid land could be purchased at $1.25 per acre provided the buyer irrigated and cultivated at least one-eighth of the tract. In 1890 the amount

that could be secured in this way was decreased to 320 acres. In 1878 the Timber Cutting act and the Timber and Stone act authorized for the first time the legal cutting and purchase of timber from the public domain.

As the 19th century neared its close, the rapid passing of the best farming lands into private hands, the rise of tenancy, and the emergence of land monopolies gave strength to the principle, long dominant and submerged, that the nation's natural resources should be conserved. In 1891 the Pre-emption and Timber Culture acts were repealed, the amount obtainable under the Desert Land act was reduced to 320 acres, the period that must lapse before homesteads could be commuted was extended to 14 months, and the president was authorized to reserve timber areas. In 1894 the Carey act granted 1,000,000 acres to certain states provided they were settled and irrigated. In 1902, under the Reclamation act, the federal government began to initiate irrigation projects on the public domain. Following the publicizing stimulus of President Theodore Roosevelt, there was steady progress in the reclamation, conservation and scientific use of land after the beginning of the 20th century. In the 1930s the National Resources Planning board studied the classification of all land in terms of inherent characteristics, current use, capacities, recommended use and program effectuation.

The Taylor Grazing Act of 1934 authorized the withdrawal from private entry of about 80,000,000 acres not suitable for crop farming and their use as grazing districts. The next year all the remaining unreserved public domain of any value was withdrawn from private entry. In 1936 the Soil Conservation and Domestic Allotment act authorized farmers to preserve and maintain soil fertility.

**Completion of Agricultural Settlement.**—By 1850 the westward-moving frontier of settlement had halted at the edge of the Great Plains, because of the Indian policy inaugurated a generation before and because the unoccupied region presented a challenge to the accepted methods of agricultural conquest. There were already isolated islands of settlement in California, the Willamette valley of Oregon, and Utah. Within 40 years the entire territory of the trans-Missouri west was occupied and began to add to the surpluses of agricultural products and to serve as a growing market for manufactured goods.

The population of continental United States numbered 23,191,876 in 1850 and 62,947,714 in 1890. By 1920 it totalled 105,710,620. That is to say, the population increased by two and one-half times in 40 years and by four and one-half times in 70 years. Immigration supplied 31,406,943 from 1850 to 1920. Reduced to simple terms, this increase in population meant more farm surpluses; but it also created a greatly expanded home market for agricultural products.

The population of the United States continued to be predominantly rural after World War I, but the rapid increase and ultimate triumph of urbanization predestined the future of the United States to a quite different social and economic configuration. The census of 1880 showed that the rural population, including towns and villages with fewer than 2,500 inhabitants, numbered 35,797,616, or 71.4% of the total population. This was more than the population of the entire country in 1860. By 1910 the rural population numbered 49,806,146, which was 54.2% of the total. By 1920, however, the census showed that the majority of the U.S. people lived in towns and cities—48.6% being classified as rural and 51.4% as urban.

**Mechanization.**—The process of agricultural mechanization began in the 18th century and is still going on. The implements used in the colonial period were largely operated by hand, supplemented to a slight extent by animal power. The first half of the 19th century brought initial inventions and improvements in machines operated by animal power for use in planting, cultivating, harvesting and threshing. The reaper was especially important because it was used at the crucial period in the production of grain crops when delay often spelled disaster. The general displacement of men by horses developed most rapidly between 1860 and 1910. The substitution, however, had hardly begun before manufacturers of farm machinery began to experiment with the use of mechanical power in place of animals. Considerable use of steam tractors in preparing and planting land was made on the prairies of the middle west. By 1905 the practicability of using the gasoline engine for power had been demonstrated. Its use on tractors was quickened by World War I, but the adaptation and perfection took place in the '20s and '30s. Almost as revolutionary in their effects were the use of automobiles and trucks; they put rural communities in closer touch with urban life and facilitated marketing. Beginning in the '30s the government program of extending electrification to farms brought illumination and power for indoor machines that did much to decrease household and farm drudgery.

Mechanization of farming brought many changes. The productivity of farm labour was increased (one estimate says 400%), and manpower was released for other activities. The farmer who could buy expensive machinery had an advantage over those who could not, and it became increasingly difficult for the man without capital to farm. The production of agricultural products and the output per capita was greatly increased. The result was the accentuation of the problem of overproduction. Mechanization prolonged extensive as opposed to intensive cultivation and gave large-scale operations an advantage. An increasing number of acres once devoted to the raising of feed for animal power could be used for the production of human food. The isolation and much of the drudgery of farm life disappeared. (*See* AGRICULTURAL POWER AND MACHINERY.)

**Improved Transportation and New Markets.**—As a generalization it may be said that the roadbuilding era of the early 19th century was superseded by a canal building and river transportation era. This, in turn, was displaced in importance by the building of a national network of railroads which provided rapid means for marketing the surpluses of the farms and ranches. In the 20th century attention was given to surfaced roads that would facilitate the farmers' access to primary markets. The increased speed of trains, specialized livestock and refrigerator cars, and systems of through transportation widened the area of competition for many commodities and hastened regional specialization. This development of a national transportation system was accompanied by comparable modernization of the marketing organization.

The transportation and trading agencies enabled an enormous volume of farm commodities to pass from the farms to the urban consumers, both in the United States and in other countries. By 1900 agricultural production was also providing more than four-fifths of the raw materials manufactured. The repercussions of U.S. agricultural exports on European economic life were far-reaching. The labouring classes were provided with cheap and abundant food, but unless protected by tariff walls the European farmer was unable to compete. The results of this situation were mirrored partly in the tremendous migrations from Europe to the United States during the 1870s and 1880s, partly by the flocking of farmers to cities, and partly by agrarian movements that clamoured for governmental relief in various forms. After the '80s, new agricultural regions were opened in Russia, Argentina, Australia and Canada, and their produce began to compete with U.S. foodstuffs in the European markets. As an exporter of foodstuffs the United States began to decline in importance after 1900. The domestic market continued to expand, but relative overproduction and maldistribution continued to plague the U.S. farmer.

**Migration of "Industries" from the Farms.**—Until well into the 19th century a distinctive feature of the U.S. farm was economic self-sufficiency. The average farm produced and processed practically everything that it needed—food, clothing, furniture, soap, candles and the many other articles essential to the farm family. The transfer of their manufacture from the farms to factories is a significant aspect of the transition from self-sufficient to commercial agriculture. It was, furthermore, the central fact of both the agricultural and industrial revolutions. This cityward migration of industries resulted in vast changes in the technical processes of manufacturing. The growth of urban communities centring about factories greatly enlarged the markets

for agricultural commodities. Specialization in agriculture was also intensified.

The industries transferred from the farms to factories may be grouped as follows. The processing of foods; the making of textiles and clothing, including boots and shoes; and the preparation of tobacco and other products for use. The first group includes slaughtering and meat packing, flour milling, the manufacture of butter, cheese and other dairy products, and the canning of fruits and vegetables. Many new industries were developed, notably the processing of beet sugar, the baking of bread and pastries and the making of confections. In 1860 flour and grist mill products ranked first among the food-manufacturing industries. By 1919 the slaughtering and meat-packing industry had taken first place. In that year the products of all food industries constituted 20% of the total value of all U S manufactures.

**Political Organization and Action.**—The great increase in agricultural trade did not bring prosperity to the farmers. Instead the three decades following the end of the American Civil War brought acute distress to many. The census of 1880 showed that the proportional share of agriculture in the nation's income was decreasing steadily. In addition to the problem of relative overproduction, the appreciated gold standard resulted in a general fall in the price level from 1875 to 1897. The farmer, by the nature of his industry, was unable to adjust his production to depressing conditions as quickly as other businesses could.

As the farmers expanded commercial agriculture, physical limitations bore down on them. Those who extended cultivation into the semiarid Great Plains were confronted with seasonal failures. Deforestation, improper drainage and faulty tillage resulted in destructive floods and unscientific cropping practices exhausted the soils in the humid regions.

All agricultural regions had particular difficulties. Eastern farmers had to compete with the cheap production of the west or turn to specialties. Western farmers were burdened with mortgages held by eastern investors. The price of land increased disproportionately to the returns that could be expected.

Living conditions on farms came to reflect the relatively small returns upon the farmer's investment and the meagre awards for his labour. The educational and recreational opportunities fell behind those of the cities. It was also apparent that the farmer was less influential in state and national politics and that policies were being shaped more and more in the interests of the rising industrialism.

The situation called for concerted organization if the farmer was to have a relatively favourable position in the national economy, but this was not forthcoming. Traditionally the farmer held back from common action. The dispersal of the farming population, the number of farmers involved, their varied and competing commodity interests, and the lack of leaders tended to thwart organization. (*See* FARMERS' ORGANIZATIONS.)

In spite of these difficulties, the distress became so real and pressing that a number of class-conscious farmers' movements were generated. Together they came to be known as the agrarian crusade. Each movement reflected the particular need and the special centre of distress of its time.

The first in order of time was the Granger movement (*see* GRANGE, THE) of the '70s in the upper Mississippi valley where the farmers had special grievances. With no regulation of their capital structure, methods and rates, the railroads and the marketing agencies that they dominated practised discriminations which so inflamed the farmers that they organized independent and antimonopoly parties between 1873 and 1876 and thus gained control of state legislations which enacted laws to fix and regulate the rates charged by railroad and elevator companies. Although lack of precedents and adequate information thwarted these attempts at regulation, the contention that such corporations were public in nature and therefore subject to governmental regulation was upheld by the supreme court of the United States. In 1887 the responsibility for railroad regulation was assumed by the federal government The grangers sought to assuage their grievances against wholesalers, distribution and credit agencies, and merchants by organizing co-operative buying and selling agencies of their own. Co-operative credit and insurance companies were also developed on a modest scale. A co-operative industrial program which called for the manufacture of a full line of farm machinery and household implements fell far short of expectations.

The Greenback movement from the late '60s onward sought to check deflation by stopping the contraction of the amount of greenback money in circulation and by having the war bonds redeemed in legal tender This type of inflation interested eastern labour and the debtor farmers of the middle west but failed to win support from the agricultural interests generally. A temporary price rise in the early '80s ended the movement, but the basic problems of currency, credit and marketing remained unsolved.

In the 1880s a variety of local organizations that developed spontaneously among the small farmers and tenants of the southwest and the wheat farmers of the northwest became the basis of the Farmers' Alliance movement, whose general program emphasized co-operative activities. In addition, the southern group proposed a federal system of warehouses and elevators where crops might be deposited in return for negotiable certificates and loans in legal tender up to 80% of the local price of the product The northwestern group urged a federal land-loan agency that would make loans upon farm land up to half of the appraised value at 2% per year. In spite of leader emphasis the members of the alliances turned to politics and eventually became part of the Populist movement.

The extremely depressed economic conditions of the early 1890s bore particularly hard on farmers and led to the formation of the People's or Populist party. Its three main objectives were reform and regulation of the disposal of the public domain in the interest of actual settlers, strict regulation of corporations and public ownership and operation of transportation and communication facilities, and raising the price level by federal note issues and the restoration of the free coinage of silver at the old ratio of 16 to 1. In the campaign of 1896 the Populists joined with the Democratic party under William Jennings Bryan and lost.

**Science Applied to Agriculture.**—In the colonial period there were individuals who applied their powers of observation to farm problems and even conducted experiments to ascertain the ways of nature and to develop better methods. In the latter half of the 18th century, leaders who sought to spread information concerning the findings of improvers and innovators began to form agricultural societies to function as educational media. In the first third of the 19th century agricultural fairs and farm periodicals were developed as additional instrumentalities in the movement. (*See* AGRICULTURAL SOCIETIES AND SHOWS.)

Public aid for agricultural improvement came slowly because the seemingly inexhaustible abundance of natural resources appeared to negate the necessity. Before 1860 state aid was limited mainly to small grants to agricultural societies to assist them with their fairs. By the '50s a few states had boards that collected information deemed pertinent to farmers. The cumulated necessity of regulating the food-processing industries and of combating animal and plant diseases and pests systematically led to the creation of state departments of agriculture in the '70s.

In the national realm, President George Washington had urged the creation of a U.S. counterpart of the board of agriculture then functioning in England, but it was not until 1839 that a unit of the patent office received appropriations with which to collect and distribute seeds and to assemble and publish information. This work was continued by the separate department of agriculture created in 1862. In addition experienced staff members conducted scientific research. The department's regulatory powers became important in 1884 when a bureau of animal industry was created to administer meat inspection and check livestock diseases. In 1889, because of increased functions and the potentialities of the agrarian unrest, the department was given full executive status and a secretary who served in the president's cabinet. The rapid and profound changes in agriculture necessitated the expansion of research, regulatory and educational functions in the department. (*See* AGRICULTURAL RESEARCH.)

There were a fair number of undertakings which offered formal instruction in agriculture during the first half of the 19th century, but it remained for the Morrill Act of 1862, which granted land endowments to state colleges offering courses in agriculture and mechanic arts, to provide the basis for the extensive system of agricultural education and research that was peculiarly American The institutions receiving the benefits of this act were slow in finding their particular place and function. In the end it was the experimental work that won recognition for the agricultural colleges from scientists and eventually dirt farmers as well. (*See* AGRICULTURAL EDUCATION )

**The Main Agricultural Regions.**—During the last half of the 19th century, the various systems of agricultural production were adapted to geographical conditions, and in consequence relatively stable agricultural regions evolved. Each region became dominated by one commodity, grown in conjunction with subordinate products and with specialties having preference in limited areas. Market opportunities, mechanization and scientific methods accelerated this regionalization.

The humid subtropical crops belt consists of comparatively undeveloped low coastal plain bordering the Gulf of Mexico and extending from Matagorda bay, Texas, to Charleston, S C. The soils have been very influential in determining which of the subtropical crops are grown in the different parts of the region and together with local differences in temperature cause the region to be divided into subregions.

The rice subregion centres in the heavy clay coastal prairie of southeastern Texas and southwestern Louisiana. In the 1880s settlers from the grain-growing middle west migrated there and began to grow rice. Irrigation was provided by artesian wells and pumping stations. About 1900, the federal department of agriculture introduced Japanese varieties that flourished. The use of machinery in the cultivation and the harvesting of the crop made the cost of production so low that the area could compete in practically any market. In 1902 mechanized rice growing was also undertaken on the grand prairie of Arkansas and in 1908 in the Sacramento valley of California.

Sugar-cane production was centred on the rich alluvial soils of the Mississippi delta after its successful introduction there near the end of the 18th century. Even after the abolition of slavery, it continued to be a large-scale capitalistic enterprise. In view of the high production costs, the industry was especially dependent upon tariff protection. The U.S. acquisition of competing areas, namely Puerto Rico and the Philippines, and a reciprocal treaty with Cuba brought new difficulties. The disastrous floods in 1874, 1882 and 1884 necessitated large-scale levee construction. After 1900 special attention had to be given to the checking of diseases and the development of new varieties. The muck soils around Lake Okeechobee in Florida also proved well adapted to the production of sugar cane.

Favoured districts of the remainder of the humid subtropical crops belt gradually developed importance as producers of subtropical fruits and trucking crops. Winter vegetables and citrus fruits flourished in Florida, and the problems were those of adaptation to local conditions and specialized marketing.

The boundaries of the cotton belt are determined largely by climate, but the density of cotton production is largely dependent on the soils. The northern boundary follows the line of 200-day average frost-free season and of 77° F. average summer temperature. The southern boundary is the line of 10-in. autumn rainfall. In the decade following the American Civil War, the attempt to continue the plantation organization with hired labour of freedmen failed, and cotton growing was shifted to small units of land operated under a share-cropping system. The crop lien given in return for the advance of supplies chained the cropper to the landlord or local merchant, but they in turn were dependent on the bankers and commission men. As cotton was a standardized marketable commodity, diversification for the market and even for subsistence was discouraged. Production was inefficient, and the costs remained relatively high. Falling prices hit the cotton south as hard as the wheat area of the west in the '80s and '90s.

The demand for cheap fibre and the utilization of cottonseed in the manufacture of feed, oil and fertilizer led to the expansion of cotton growing westward to the subhumid line in Texas and northward to the frost line in Oklahoma, Arkansas and Tennessee. Simultaneously the use of commercial fertilizers revived the industry in Georgia and the Carolinas. By 1880 cotton manufacturing began to be established in the southern Piedmont, and eventually these mills fabricated more than half the cotton crop.

Cotton growing was imperilled by the ravages of a devouring beetle known as the boll weevil which crossed the Mexican border into Texas in the 1890s and progressed eastward across the cotton belt. To offset the losses, cotton farmers turned to other crops to some extent, but the main relief came from the introduction of improved methods of cultivation and hardier varieties of cotton. This campaign for improvement directed by Seaman A. Knapp provided the basis for the extension service of the federal department of agriculture.

Tobacco growing is widely distributed in the United States, but the cultivation of the main types has centred in the borderland between the south and the north which is sometimes known as the corn and winter wheat belt. The bright-leaf flue-cured tobacco, used in cigarettes, became the major crop in northern and eastern North Carolina, and Durham and Winston-Salem became great centres of tobacco manufacture. The heavy dark burley tobacco needed for foreign markets centred in western Kentucky.

The middle Atlantic trucking region extends along the Atlantic coast from Charleston, S.C., to Portland, Me. It developed mainly because of three conditions: the large markets for fresh vegetables and fruits provided by the large cities within or near the area; its sandy soils that respond to cultivation and fertilization; and its mild climate with a long frost-free season.

The hay and dairying belt includes the portions of the cool humid northeastern United States and adjacent Canada in which agriculture generally is more important than the forest industries and dairying is the dominant interest. The southern boundary is approximately the line of 69° mean summer temperature in the west and 70° to the eastward. With the growth of industrial centres the eastern portion of the region gave increasing attention to the production of fluid milk. Wisconsin became the leading cheese-producing state, and Minnesota and Iowa specialized in buttermaking.

Between 1880 and 1914, dairying made notable progress in production, processing and marketing. Better dairy cattle were introduced and developed. The silo was adopted as a method of preserving corn and its green fodder for feed, and increased attention was given to forage crops. The cream separator simplified a hitherto time-consuming process, and the butterfat tester provided an accurate and quick method of measuring butter content. The condensing process was perfected. Milking machines were invented. Dairymen pioneered successfully in the co-operative processing and marketing of their products. Between World Wars I and II the dietary habits of the U.S. people gave greater emphasis to the value of dairy products.

The wheat regions developed in accordance with the conditions necessary to wheat growing. Wheat was the characteristic crop on each frontier across the northern and western United States. The prairies of Illinois were the main centre from 1860 to 1880. Minnesota ranked first during the next two decades and then gave place to North Dakota. During World War I Kansas became the leading centre. Winter wheat was continued as part of the general farming of the borderland corn and winter wheat belt. In contrast, hard spring wheat continued northwestward in a region having the bare requisite humidity and also to the Pacific northwest. This movement was made possible by the development of new varieties of wheat, resistant to drought and rust, and to innovations in methods of cultivation, especially power mechanization.

Corn continued to hold the basic place in crop systems and stock raising that it had early assumed in the colonial period and was, therefore, grown in all cultivable belts. Like wheat, its main centre of production moved westward but, unlike the other cereal, it halted when it reached the prairies of the middle west which

were predestined by the unique combination of soils and summer temperature and humidity to become the corn belt. The large-scale preparation of hogs and cattle for market followed corn into the region

Because of the importance of corn and hogs to the region, special attention has long been given to the improvement of both In the 1890s corn breeders followed the mirage of uniformity and symmetry, and it was not until after World War I that the importance of hybridization came to be recognized. In response to consumer demand, the old heavy lard hog was evolved into a younger light bacon type. The value of hogs made the checking of virulent diseases imperative, but it was not until 1913 that a preventive serum was developed for hog cholera.

The valleys of central and southern California and the coast south of Santa Cruz have been designated the Pacific subtropical crops region. The Spaniards utilized three institutions—the presidio or military establishment, the pueblo or colonial settlement, and the mission—to occupy the region. Of these the last was by far the most significant as missions became centres of agricultural development. Although the friars introduced the fruits of their Mediterranean homeland to the mission gardens, cattle raising was the dominant occupation during the Spanish-Mexican period, 1769–1848, and continued to be until [illegible] ended it as a distinctive industry. Sheep raising recovered from the droughts, reached its peak in 1874, and then began to decline. In the years 1870–90 wheat farming reached bonanza proportions in the San Joaquin valley. Although the gold rush following 1849 stimulated attention to fruit raising, the experimentation and development necessary to capture a national market took place only after 1869, when the first transcontinental railroad was completed. By 1890 the people of the region knew what crops to emphasize and where to raise them, and the solutions of the problems of water supply for irrigation and of marketing were generally evident.

The humid portion of the Pacific northwest and also its irrigable valleys, like semiarid California, became a region of special crops. The Hudson's Bay company had farms to supply its helpers with food. The pioneers who migrated over the Oregon trail and settled in the Willamette valley in the 1840s also carried on general farming. Once the prairies were occupied, the high cost of clearing land in the region became and remained a big factor. It was necessary, therefore, for each valley and locality to specialize on crops which, by virtue of quality, could hold their places in the national markets.

The grazing and irrigated crops region was initially merely a strenuous barrier to those of the east who wished to reach the gold of California and the fertile lands of Oregon. As the gold production of California declined, the miners turned to the unoccupied valleys and mountain ranges to the eastward. Their rush into what is now Colorado laid the basis for permanent settlement there. The miners' occupation of Nevada, Arizona, New Mexico, western Montana, Idaho and eastern Washington took place during the American Civil War. The need of food supplies for the mining camps prompted the beginning of agriculture in the valleys. The completion of the Union Pacific railroad in 1869 brought a flood of hunters who exterminated the buffalo and thus left the Great Plains for occupation by the range-cattle industry. The success of the Union Pacific led to the building of four other transcontinental lines. Thus, the region, in contrast with the east, had facilities for rapid transportation prior to, rather than after, intensive settlement and exploitation. For two decades after the American Civil War, a vast cattle industry thrived on the open range. Then the railroads brought homesteaders and other land seekers who disrupted the range and forced the cattlemen to shift to a ranch basis. The invention of barbed wire for fencing in 1874 facilitated this step.

The fact that much of the land received less than 20 inches of rainfall annually foredoomed the transplanting of eastern ways of agriculture and necessitated the development of new methods and crops. Irrigation and dry farming became important in the United States for the first time.

**World War I.**—In terms of agricultural production and marketing, the war period extended from the fall of 1914 to the spring of 1921. During the first two years production was not markedly stimulated, and the trade in certain commodities, notably cotton, was depressed. With the entrance of the United States into the conflict in 1917, an unprecedented program of agricultural production, especially of cereals and meat, was undertaken. To this end the new extension service created by the Smith-Lever Act of 1914 and the county-agent system acting with farmers' organizations were utilized.

Wheat was the cultivated crop most needed. The price was fixed by the federal government to encourage its production The acreage increased more than 50% and its production 38%. More than one-quarter of the expansion was in the corn belt at the expense of other small grains, corn and grassland; most of the remainder was in the Great Plains. The demand for fats greatly stimulated hog production; more than 1,000,000,000 lb. of pork were exported in 1918 as compared with a prewar 5-year average of 450,000,000 lb. The dairy industry also expanded notably to supply the export demand for concentrated milk and the larger domestic demand which resulted from increased purchasing power.

The war years accentuated a complicated economic situation for the farmers. Their returns varied greatly according to commodities; the prices of wheat, hogs and tobacco were relatively high, whereas those for horses, cattle, butter and eggs were relatively low. Inflated values largely accounted for the general high level of prices, and this influence increased markedly the farmers' living and production costs. Land values rose as much as 70%.

**Postwar Depression.**—The price decline that began in 1920 affected agricultural products first and hardest. Following the withdrawal of credits, the foreign markets disappeared, and yet the farmers' fixed costs continued. Instead of curtailing output, the agricultural industry sought to meet the situation by increasing production even though it had to sell at low prices. The industrial and financial boom of the middle '20s brought only a limited improvement to agriculture. At the boom peak in 1929 the index of [illegible] prices was only 91% of the prewar level, and it had fallen to 50% by Feb 1933. Gross farm income, which had risen from $7,000,000,000 in 1914 to $17,000,000,000 in 1919, fell to a little more than $5,000,000,000 in 1932.

This agricultural distress of the 1920s affected the various regions at different times and with varying degrees of intensity. During 1920–22 the spring-wheat region was the centre of distress and protest. In 1923 the decline in the hog market resulted in farm foreclosures and bank failures in the corn belt. Although the south early sought relief for specific products, it was not ready to demand a general program of relief until 1926.

Beginning in 1921 an agricultural bloc of western and southern congressmen sponsored emergency and long-time measures of relief and stabilization for agriculture. In 1923 intermediate credit banks were authorized to make short-term loans on livestock and farm commodities. The McNary-Haugen plan proposed to dispose of the farm surpluses abroad and to finance this procedure by an equalization fee assessed on the producers, but bills embodying the plan were twice vetoed by President Calvin Coolidge. In spite of the fact that the nation had shifted from a debtor to creditor status, the successive administrations from 1921 to 1933 placed much emphasis on protective tariffs to establish and maintain cost-of-production prices for the leading farm products in the home market.

Although the administrations were against large-scale government action, continued distress led to the creation of the Federal Farm board in 1929 to support and promote co-operative marketing associations as a means of controlling output and thus ensuring profitable returns.

**New Deal Measures.**—The agricultural policies of the Franklin D. Roosevelt administration from 1933 to the outbreak of World War II passed through several stages. To meet the emergency of price collapse, the Agricultural Adjustment Act of 1933 authorized extreme measures for the reduction of production and compensation payments from a tax on processors. The success attending the program for cotton, wheat, corn, hogs and tobacco in 1933 led to its expansion in 1934 to include beef and dairy

cattle, peanuts, rye, barley, flax, grain sorghums, sugar beets and sugar cane. At the same time submarginal farmers were encouraged to withdraw from commercial production, and the administration initiated a policy of reciprocal tariff agreements with other countries to encourage the export trade in agricultural products. Despite the widespread criticism of crop reduction by the consumers who were saddled with its cost and despite the disadvantages attending it, the economic conditions of the farmers rapidly improved. Supplementary legislation expanded the credit facilities for farmers and attacked the problem of tenancy. In Jan. 1936, the supreme court held the act of 1933 unconstitutional, and the administration had to turn to other media of action.

The danger of shortages and the tragic results of soil destruction were emphasized by the droughts that culminated in the dust storms of 1935 and 1936. The soil conservation service was created in 1935 to conduct soil erosion surveys and carry out preventive measures. The Soil Conservation and Domestic Allotment Act of 1936 provided $500,000,000 for the preservation and improvement of soil fertility, the promotion of the economic use of land, and the protection of rivers and harbours from soil erosion. For two years co-operating farmers received direct aid, after which responsibility for the program was shifted to the states that enacted suitable legislation and provided a conservation plan acceptable to the federal department of agriculture.

A comprehensive and long-time program was provided by the Agricultural Adjustment Act of 1938, which emphasized and provided for an "ever-normal granary." As in earlier acts, the initial aim was the establishment of prices for wheat, cotton, corn, tobacco and rice at a level in relation to the cost of commodities bought by farmers in 1909–14 (for tobacco the parity base was 1919–29). The act provided machinery for soil conservation and balanced output, loans, marketing quotas, marketing aid and promotion and parity payments. A new feature was crop insurance for wheat.

During the years 1933–38 economic planning was carried further with respect to agriculture than for any other economic interest. The federal government assumed responsibility for determining both production and prices as well as maintaining soil resources and providing most of the farmers' credit needs. Before the full program as outlined in 1938 could be tested, agriculture as part of the national economy became involved in a global war.

**World War II.**—The production record of U.S. agriculture during World War II was phenomenal. The increase in total production from 1939 to 1944 was twice as large as during the preceding 20 years. The gross farm production in 1944 and again in 1945 averaged 124% of the prewar years 1935–39. The wartime achievement was accomplished without significant expansion in the crop acreage and in spite of shortages of labour, machinery and other supplies. Even though one-fourth of the food output went to military and other emergency uses, there was food enough in 1944 and 1945 to provide the civilians with a per capita food consumption about [illegible] than before the war. Although extremely favourable weather was a factor, it accounted for only about one-fourth of the total increase. The main motivation for increased production was the doubling of the prices received by farmers for their products which resulted from the wartime needs, but the large-scale increase was made possible by a number of factors that had been building up potential production capacity during the 1930s.

Mechanization was the most important factor. The number of tractors on farms increased from less than 250,000 in 1920 to more than 2,000,000 in 1945. The shift to mechanical power during these years released for the production of commodities for human use about 55,000,000 crop acres, or about 15% of the available cropland, once used to grow feed for draught animals.

Another important factor was the increased use of lime and fertilizer. In terms of plant nutrients the total consumption of commercial fertilizer in 1944 was 85% above the quantity used in the years 1935–39, and the use of lime was nearly three times as large. Official estimates placed the increased production resulting from the additional use of lime and fertilizer in 1944 at about 15% of the total increase in output after 1935–39.

The adoption of improved crop varieties was another important source of increased production. The use of hybrid seed corn added 400,000,000 bushels to the 1944 crop. New varieties of oats were introduced in the corn belt, the Great Lakes states, and the southern states. The war years also accelerated the adoption of more productive and more nutritious legume hays.

The production of crops especially needed during the war was greatly expanded. The harvested acreage of hemp for hard fibre was increased from 1,246 acres in 1935–39 to 146,200 acres in 1943. The acreage of soybeans harvested for seed and for crushing in 1944 was 241% of that acreage in 1939. The acreage of flaxseed for oil in 1943 was more than three times the average of 1935–39. The production of peanuts, beans and peas for human food was greatly increased. In addition to these crops which affected large areas, there were others whose production was concentrated in small areas, notably vegetable [illegible] castor beans and some pharmaceutical plants grown to alleviate war shortages.

A number of forces accounted for the increased marketings of livestock and livestock products. The current feed production permitted an increase in livestock. In addition, the shift to mechanical power released additional feed for animals that are grown for human use. The supply of feed was also more balanced with respect to protein and other nutritive elements. Livestock production also increased in output per unit of feed.

The wartime production record was achieved despite a decreasing labour supply. The total farm population dropped from 30,000,000 in 1940 to 25,000,000 in 1945, and the number of farm workers was 8% less in 1944 than in 1935–39. Nevertheless, by utilizing all the mechanical power available and working longer hours, the farmers and their families were able to develop the potential agricultural production capacity of the nation and make it the great food arsenal of the United Nations.

**Agricultural Chemistry.**—Agricultural chemical investigations in the United States are conducted in all the bureaus of the federal department of agriculture except those concerned exclusively with economic research and action and regulatory programs, in the agricultural experiment stations of the states and territories, in the universities and research institutions, and in the laboratories of the food-processing plants and industries which utilize agricultural products.

At first the agricultural chemists were almost exclusively concerned with the chemical control of commercial fertilizers and the study of fertilizer action upon the growth of plants. The study of cattle feeds for regulatory and research purposes was next taken up, and finally, with the passage of state and federal pure-food laws, the diet of man began to be investigated—first for the prevention of adulteration and then for the improvement of human nutrition. The sequence of plants, animals and man, although seemingly illogical as regards importance, was the natural order of research development. The passages of state and federal laws governing the purity of insecticides increased further the regulatory work of agricultural chemists, and most of the experiment stations shortly found control work so disrupting to research that the former was separated from the latter and transferred to state chemists.

The policy of separation was also adopted by the federal department of agriculture in 1927 when the inspection control of food and drugs, insecticides, tea and naval stores was transferred from the bureau of chemistry to a purely regulatory Office of Food, Drug and Insecticide Administration. By this time agricultural chemistry had become so vast a field of research that scientists spoke and worked in terms of its subsidiary sciences rather than the subject as a whole.

The lines of chemical research emphasized in the various experiment stations depended naturally upon the predominant agricultural needs of their states. Chemical investigations relating to dairy products were stressed in New York, Wisconsin, Minnesota and other leading dairy states; those concerned with flour in the wheat-growing states; those upon sugar production in the cane-growing states of the south and the beet-producing states of the west; and those upon corn in Iowa and the other large corn-grow-

ing states.

Examples of pioneer specialization with more than regional applicability were the lysimeter studies upon percolation in soils in Tennessee, the research on alkaline soils in California, and the studies of vegetable proteins in Connecticut and of animal calorimetry in Pennsylvania.

Among the more important chemical projects of the federal bureaus were investigations upon soils, fertilizers and nitrogen fixation; foods and food technology; human and animal nutrition; plant constituents; insecticides and fungicides; chemistry and technology of tanning materials, leather, paper, fabrics, sugar, starch, oils and fats; meat, dairy and forestry products; storage of cereals, vegetables and fruits; deterioration of agricultural products; spontaneous combustion; dust explosions; and methods of agricultural chemical analysis. In the 1930s greatly increased attention was given to studies of the industrial uses of agricultural products, by-products and wastes. Simultaneously the research work was largely transferred from Washington to the Agricultural Research centre at Beltsville, Md., and to four regional laboratories at Wyndmoor, Pa., Peoria, Ill., New Orleans, La., and Albany, Calif.

During World War II agricultural chemistry research made many notable contributions to the war effort, including the development of penicillin, synthetic rubber and plastics, the dehydration and compression of vegetables and eggs, and the stabilization of nitrated cotton for explosives; many of these and similar projects will be redirected to peacetime needs. (For the early history, *see* Charles A. Browne, *A Source Book of Agricultural Chemistry* [1944]; for the United States, *see* Charles A. Browne in the American Chemical Society's *Journal,* v. 48, no. 8a, pp. 177–201 [1926].)

**Experiment Stations.**—In the United States agricultural experiments were early conducted by the agricultural colleges, but not until 1875 was the first experiment station with state support established. It was located at Middletown, Conn., under Wilbur O. Atwater and later was moved to New Haven with S. W. Johnson as director. The University of California next provided for a station at Berkeley, under the leadership of E. W. Hilgard. Other states followed, and by 1887 there were 18 stations.

The movement for a nationally supported system of experiment stations culminated in the Hatch Act of March 2, 1887. It authorized an annual appropriation of $15,000 for a station connected with each of the agricultural colleges established under the Land-Grant College Act of 1862. This gave a marked impetus to the experiment stations, and states which had not previously provided them promptly took advantage of the act. In 1906 the fund was supplemented by the Adams act, designed especially to promote original scientific research on agricultural problems. On its maturity in 1911 this act doubled the annual federal support. As the nature of the Adams fund required separate accounting, the project plan for experimentation came to be adopted generally at the stations.

Federal aid was again enlarged in 1925 by the Purnell act, which authorized an increase of $20,000 to each state the first year, with annual additions of $10,000 until $60,000 was reached. It also extended the research covered to include agricultural economics, home economics and rural sociology. By 1930 each state was receiving $90,000 of federal funds and providing an average of about three times as much for station work. The Bankhead-Jones Act of 1935 provided substantial funds for federal regional laboratories which co-operate closely with the state stations.

The state stations established experimental fields and trial grounds, accommodations for experimental animals, insectariums, creameries and cheese factories, veterinary hospitals, and laboratories for chemical, botanical and bacteriological research. They publish bulletins, circulars and annual reports containing the results of their work. Popular articles are prepared for the press, while the more technical features of research are published in appropriate scientific journals

The stations have close contact with the farming public and with extension workers The results of experiments are thus spread broadcast, often being applicable far beyond the states where the investigations were carried out.

The experiment stations in Alaska, Guam, Hawaii, Puerto Rico and the Virgin Islands are maintained under the federal department of agriculture with special congressional appropriations. Many of the states have branch stations dealing with special enterprises, such as citrus fruits, sugar, rice and tobacco or with the special problems of localities. There are also a number of special stations in the states without federal aid.

In addition, there are a number of privately supported centres like the Boyce Thompson Institute for Plant Research at Yonkers, N.Y., and the Marble laboratory at Canton, Pa., for the study of fruit storage.

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(E. E. Es.)

**AGRICULTURE, CENSUS OF.** A national census is a periodic stocktaking or inventory of the population, material resources, production and social conditions of a country and its people. The early censuses were simple counts of population by age and sex mostly for political and military uses. In a modern census schedule, scarcely any subject about which a group may have developed an interest or curiosity is too particularized to find a place—such items, for example, as the number of deaths from cancer, the number of restaurants selling cigarettes and tobacco, and the state of repair of plumbing equipment in buildings. Or to cite items from agriculture, immigrant farm operators in Canada according to period of residence and farming experience, pounds of grain fed to fish in artificial ponds in Czechoslovakia, amount of peat used for litter on farms in Finland, or number of farm dwellings with running water in the United States. Censuses of agriculture, however, concern themselves especially with the number and size of farms or holdings, the uses of the land, the acreage and production of crops, the numbers of livestock and volume of livestock production, quantities of wood cut for various purposes, and the numbers and classes of farm workers. At least these were the subjects included in the First World Agricultural census, taken in 1930.

Supplementary subjects, to be included by those countries that could afford them, were farm tenure, farm machinery, use of fertilizers, nursery and greenhouse establishments, and irrigation and drainage.

**Purposes Served.**—A distinction is usually made between an agricultural census, taken perhaps at intervals of ten years, and the customary annual reports of acreage of crops, numbers of livestock, and crop and livestock production, summarized in the *International Yearbook of Agricultural Statistics* by the International Institute of Agriculture (*see* AGRICULTURAL STATISTICS) A census is likely to be more comprehensive and to include items in which changes from one year to the next are not very significant, or for which a full record over the years is not needed. Data on food production, for example, must be complete for successive years if they are to answer important questions on the food supply. If only decennial census data were available, the production of the intervening years would need to be interpolated.

The distinction between a census and an annual report, however, became less clear as more items were included in the annual inquiries. For many of the remaining items, new sampling procedures were developed to provide reasonably accurate statis-

tics at much lower cost. Thus a 5% sample of farms may furnish the facts needed as to the increase in electrical installations on farms, or introduction of a new variety of cotton, or change in the method of hiring labour or leasing systems. Some countries, like the U S.S.R., rely almost entirely on annual statistics If information on a particular subject is needed at any time it may be added to the next annual enquiry. Some countries, like Great Britain, were collecting annual statistics long before their first agricultural census. Great Britain took her first agricultural census in 1908, and her third in 1932 in connection with the first world agricultural census. The United States took its first agricultural census in 1850. A few of its annual series were begun in 1860.

It appears, therefore, that a census of agriculture does not stand by itself. It is only one part of the large undertaking of keeping a running inventory of the agriculture of a country and recording and measuring the changes in its structure, organization and social conditions. A census takes a somewhat detached cross section every ten years or so; and an annual enquiry a more frequent but less inclusive cross section. Certain other types of change, such as in livestock production, in condition of crops and pastures, in market receipts and prices, and in stocks on farms and in warehouses, need reporting monthly or oftener. All three of these types of enquiries fit together to give the full record Properly integrated, each also assists and strengthens the other. The census data become benchmarks against which the year-to-year changes are measured. Each new census provides a check on the accuracy of the annual estimates that have been projected forward from the last census. The annual reports similarly become benchmarks for the monthly reports. Data on market receipts provide checks on census data on production.

Since these three types of enquiries are so interrelated, it is important that they employ a common statistical language. This means using the same terminology, units, classification and area subdivisions. The data from any one of these sources need to be comparable with those from the other two. For example, the census should not assemble data on crop land sown and the annual enquiry report only crop land harvested. Hence, a country should either have only one statistical organization for assembling and compiling these three types of agricultural data, or it should give some unit of government the authority to co-ordinate the work of the separate organizations.

## THE WORLD AGRICULTURAL CENSUS

Agricultural statistics need to be comparable among countries as well as within a country. This need and that for a more complete coverage of the agriculture of the world, led to the attempt, under the leadership of the International Institute of Agriculture, to obtain a world agricultural census in 1930. The general assembly of the institute adopted a resolution to this effect in 1924. By 1928, a standard form or schedule of questions had been developed and approved by the general assembly. Committees of statisticians and agricultural economists from the countries adhering to the institute met at Rome in 1925, 1926 and 1928 and helped plan this enquiry. The Rockefeller foundation assisted with a five-year grant. Leon M. Estabrook, previously in charge of the crop and livestock reporting service of the United States department of agriculture, directed the institute's part of the work. In 1926–28, he visited 61 countries in order to interest them in taking part in the proposed census of 1930–31 and to discuss with the statistical authorities in these countries the details of the task of taking the census. As a result, 63 countries, out of a possible total of 200, participated either by carrying out a complete census, or to use the exact language of the census report (Vol. I, p. 71) "by making special inquiries or by attempting to obtain and furnish the Institute with information, for the census year, more complete and exact than normally available." These 63 countries included more than half the area and population of the world, and if China and the U.S.S.R. were excluded, about two-thirds of the remaining area. The list of 63 countries included 23 in Europe all of North America, 6 countries in Asia, 11 in Africa, 6 in Oceania, 5 in South America and 8 in Central America.

The individual countries handled the tabulation and compilation of the data of the census returns and in most cases published the results in their own principal language. The International Institute of Agriculture undertook to prepare summaries of the census reports of the individual countries as they became available, and to publish these summaries in English and French. In 1939, 39 of these summaries were assembled in Vol I to V as the *First World Agricultural Census*, together with "the standard form," a "methodological study" on the experience of taking this census, and "Notes on Tabulation of the Census Results" (in Vol I).

In the meantime, preparations were made for the second world agricultural census to be taken in 1940–41. The bureau of statistics of the institute prepared a revised standard form, and this was reviewed by a group of statistical experts from different countries in Oct. 1936. The revised standard form resulting was then sent out to all the nations for criticism and suggestions. The replies received were summarized in a pamphlet, "The World Agricultural Census of 1940, Documentation for the Second Conference on Agricultural Statistics" published in 1937. The second conference was held in Dec 1937 and the revised schedule was sent out in 1938. During World War II the staff of the institute summarized the census reports of the different countries as they became available. Part of them never became available because of the war.

The 1930 world census of agriculture made a special effort to collect useful data on the subject of labour employed in agriculture, because of the interest in this subject developed by the International Labour office. The 1940 census undertook to expand further this phase of the enquiry. The League of Nations also developed a strong interest in nutrition in the 1930s. Following a resolution introduced in 1935 by High Commissioner S. M. Bruce of Australia, a Mixed Committee on Nutrition of the League was appointed to consider the possibilities of relieving agriculture by getting its surpluses consumed by the world's underfed peoples. By 1938, national nutrition committees had been formed in 21 countries. This rapidly-growing interest in nutrition was recognized in the 1940 world agricultural census by an attempt to get a fuller reporting of all food production and especially of the production of milk and other foods of high nutritive value. The resolutions of the United Nations Conference on Food and Agriculture held at Hot Springs, Va., in May 1943 called for still more emphasis on collecting the data needed for a world program designed to place "adequate food . . . within the reach of all men in all lands within the shortest possible time," and the program for the international Food and Agricultural organization calls for developing more complete and accurate statistical information, and devising more effective methods of obtaining it.

## THE CONDUCT OF AN AGRICULTURAL CENSUS

Most persons who know about censuses at all think that there is only one way of conducting them—the way in which they are conducted in their own country. Actually the methods differ widely, usually for historical reasons. The original need for information determined the method which was followed after that. The original need may have been for a list of all the persons of age suitable for military duty, or for a listing of property for taxing purposes, or, as in the United States, for a count of the people in order to apportion them into voting districts.

**Methods of Collecting Data.**—The "Methodological study" Vol. I, p. 72, *The First World Agricultural Census* distinguishes between two major methods of collecting census data: making a record for each farm, and making estimates on the basis of data from existing sources or from samples. All but 17 of the 63 countries participating in the 1930 census used the first method. In 6 of these 17, France, Algeria, Peru, India, Japan and "probably El Salvador," the data were reported by communes or other administrative units. In making up the report for the commune, the local officials may have obtained some of the information directly from individual farmers, or may have depended in part on the annual data collected from individual farmers. The remaining 11 countries, all colonial, made approximate estimates by

combining the results of special surveys with pre-existing information.

The countries making a record for each individual farm may not have made an actual farm-to-farm canvass. Instead they may have filled in a schedule for each farm without visiting it by combining existing cadastral or other information for each farm with estimates of yields and crop acreages obtained from annual crop and livestock reports. Numbers of livestock for each farm may have been obtained in the same way or from tax records. Many countries making a farm-to-farm enumeration before 1930 had obtained data only on acreages of land and crops and numbers of livestock, and had compiled their production data by applying to these data average yields per acre or production per animal obtained from other sources. Most of these countries continued this practice in 1930, and the instructions for the 1940 census contain explicit directions for this as an alternative method of determining production.

The actual farm-to-farm enumeration may, in turn, be made in several ways. The method favoured by the International Institute of Agriculture is to have specially-trained enumerators obtain the information verbally; or to mail the schedule to the farmer to be filled in by him before the enumerator calls in person to collect it. In the latter case, the schedules need to be checked carefully before the enumerator leaves. In many countries, however, a local administrative official, or the rural police, distributes and assembles the schedules. This may result either in an incomplete census, or in one not very reliable because many schedules are completed in the office.

If special enumerators are employed, they need to be properly equipped and trained. In the United States and several other large countries, a new staff of enumerators is organized for each census; and under these circumstances very little of the training and experience gained in one census is carried over to the next. The best administrative setup is a regular staff which collects the annual as well as the periodic census data, and also helps with the monthly reports and the office work. This setup is easily arranged when all three types of agricultural statistics are collected by one organization.

**Date of the Census.**—The desire of the planners of the 1930 world census of agriculture was to obtain crop and production data for the calendar year 1929 in the northern hemisphere, and for the comparable year beginning July 1929 in the southern hemisphere; and to have a similar census taken each ten years thereafter. It was hoped that the different nations would shift the year of their enumeration to fit into this schedule, by 1940 if not for the first census, so that thenceforth the data would be comparable in time. Germany had taken an agricultural census for the crop year 1925 and waited until the crop year 1933 to take another. Sweden, Great Britain, Canada and four other countries were from one to three years late for similar reasons. The same difficulties arose in 1940. For example, Argentina and Chile had taken censuses in 1937 and were not able to repeat them.

The United States and a number of other countries take quinquennial as well as decennial censuses of agriculture. Great Britain made plans for this at the time of its census of 1908, but World War I interrupted the 1913 enumeration and the returns were never tabulated. The reason for shifting to a 5-year interval in the United States was that some of the annual estimates projected forward from the last census were proving to be seriously in error after seven or eight years.

The time of year for taking an agricultural census is also important. The best time for a census that includes production is after the principal crops are harvested and before the migratory workers and other operators customarily do their moving from farm to farm. This means November to January in the northern hemisphere. The countries which obtain only crop acreages and livestock numbers, however, are likely to prefer the summer months when livestock numbers are largest. The census officials of the United States asked that the date of enumeration be shifted from April to a winter month, but congress, after acceding to this request in 1920, refused to do so again for any decennial census—too much of the population gets counted in Florida or California in the wintertime.

**What Farms to Include.**—No problem in census taking has caused more difficulty or dispute than that of what types and sizes of rural establishments or holdings to consider as farms. Those which have looked at the problem from the point of view of classifying the population according to its major source of income have wanted to set a relatively high requirement. Those which have been concerned over obtaining a full enumeration of all agricultural production have wanted a very minimum limit. Most countries have a large number of very small farms, or of families producing small amounts of agricultural products for use of the family or for sale, or for both, and a slight change in the definition of a farm will change the count greatly. Part of these families have another principal occupation or source of income. Others have only very small incomes which are nearly all in the form of food and other products consumed directly by the family. Although the United States kept the same definition of a farm after 1910, changes in the instructions to the enumerators in 1930, 1935 and 1940 caused the number of farms to fall from 6,448,000 to 6,289,000 between 1920 and 1930, to rise to 6,812,000 in 1935, and to fall to 6,100,000 in 1940. In one eastern seaboard state, the number of farms reported almost doubled from 1930 to 1935.

The standard definition of a farm in the first world agricultural census was as follows.

"A farm, for census purposes, is all the land used wholly or partly for agricultural or live stock production, that is operated, directed, or managed by one person alone or with the assistance of others, without regard to ownership, title, size or location, and may be in one or more separate pieces if they are in the same neighbourhood and are known and operated as a single holding or property. The person who operates or directs the farm may be owner, tenant, hired manager, or one who holds or controls the land and its products under a special form of tenure . . . The farm may be known as a lot, piece, or parcel of land, garden, orchard, estate, ranch, plantation, rural establishment, proprietorship, or other name, but in any case must be operated, directed or managed by one person. Woodland and forest land that forms a part of the farm or holding and is controlled, directed or managed by the farm operator will also be reported as well as the plots of ground and buildings occupied and utilized by the laborers employed and living on the farm."

Thus no common lower limit was placed on size. The Netherlands and Austria, at one extreme, set the limit at one-eighth of an acre; the United States, at the other extreme, at three acres, or less if the value of the product was $250. In Great Britain and the empire countries, the limit was commonly one acre. In Northern Ireland however it was one-fourth of an acre, as also in Eire; and in the Union of South Africa, one morgen (2.1 ac.). The other continental European countries set limits ranging from a quarter of a hectare (in Finland), to a half-hectare (Germany and Belgium), to one hectare in Latvia, Estonia and Lithuania. (Hectare=2.47 ac.) These Baltic countries, however, had a special schedule for establishments of less than a hectare.

Qualitative differences also enter into the problem of what constitutes a farm. In some countries, kitchen gardens and backyard poultry flocks on land adjoining a non-farm dwelling are not included as farms. In Switzerland the question is whether or not any of the product is sold. In New Zealand such production is excluded if it is within borough boundaries; in Italy, if it is in cities of 15,000 or more inhabitants. Practice also varies with respect to livestock not on farms.

Much confusion also arose in the first census over considering separate units under one landlord as all one farm, or each unit as a farm. In France, the practice was to call them one farm. The general rule which the census makers would like to apply is that any land under a *single management* should be considered a farm. But share-croppers contribute only part of the management, in many situations less than half of it. Italy and Yugoslavia met this problem by having a supplementary schedule for central managements. The United States used a supplementary "plantation" schedule in its 1940 enumeration. The 1940 world agriculture census tried to meet this difficulty in part by using the terminology "farm or holding" in place of "farm." But in some countries, any parcel of land is called a holding whether or not it is independently operated. Also in the countries of central Europe, where much land is operated under managers, one overseer may look after several holdings.

It follows from the foregoing that the census totals on number of farms and farm operators for the various countries are far from being comparable; yet these are among the most significant measures of agricultural change. This difficulty will not be overcome until the enumerators are required to return a schedule for all agricultural production down to a very low minimum, and the final classifying is done in the office subsequently. One cannot expect enumerators to apply uniformly an involved census definition like that for a farm or holding.

**Tabulation of the Returns.**—Before tabulation can begin, the returned census schedules must be edited. This involves checking the figures on each schedule for internal consistency and comparability with other returns, and perhaps a good deal of filling in of gaps in the schedules. Practice varies as to the extent of the latter. If the gaps are not filled in, either the farms with partial returns must be omitted or the published tables must report for each item the number of farms with no reports, letting the user of the tables do his own estimating if he wishes. Most statistical offices follow a combination of all three of these procedures, the choice in each case depending upon which introduces the least error. For example, the debt status of farms with

no report on mortgage debt cannot safely be estimated, whereas production frequently can.

The comparability of the census data of different countries may be improved greatly if a uniform classification of farms and land by size can be applied in the tabulation process, and ... according to use, livestock according to age, farm ... to age and employment, etc. The planners of the two world agricultural censuses gave much attention to developing such classifications and the data published in Vol. II to V show the effects of this.

## SUBJECTS OF CENSUS ENQUIRY

The conduct of an agricultural census, even in any one country, in such a way as to obtain data that are comparable from one enumeration to the next and from one region or province to another is an unusually difficult undertaking. Adding comparability by countries makes the task seem imponderable. The world was not made to fit the requirements of simple and accurate census taking. Rather, a census must adapt its methods to the infinite variety and complexity that man has introduced into a physical environment already diverse enough in itself. In the sections following, these adaptations will be considered according to the main subjects included in the two world agricultural censuses of 1930 and 1940.

**Farm Labour.**—In spite of the growing interest in farm labour, only questions relating to "permanently employed" workers were considered safe to include generally in the 1930 census. The questions included age over or under 15, sex, and whether or not members of the farm family. Even then, only 35 of the 63 countries included these questions in their enquiries. Similar questions as to temporarily employed workers on the date of the census were included under the supplementary questions, also questions as to number of days worked, wages, housing and hours worked per day. Only 14 countries, however, included any of these questions in their schedules. Some of the 35 countries attempted to classify farm labour in other ways than suggested in ... form, using such designations as administrative staff, overseers, foremen, farm servants, artisans, shepherds, cowmen, ploughmen and vine workers. The farm labour part of the standard form was discussed at length in planning the 1940 census. The principal change was to define the term "permanently employed" to mean employed during a crop season only, or regularly over the year. In both censuses, the countries were also asked to report the particular employment conditions on the date of the census, and something about number employed at other seasons.

**Land Use.**—Since land is the basis of all agriculture, the most important classification in any agricultural census is that of its lands by major uses. A major problem is that of classifying lands that have mixed use as pasture and woodland. The United States census uses the designation "woodland pasture" for such lands. The world census calls for classifying it either as woodland or as permanent pasture or meadow—according to which is the more important use. This is a definite advantage in case one wishes to work out ratios of farm population, workers or animal units to agricultural land; or analogous ratios for woodland and forest.

A similar problem is that of classifying land once tilled but in pasture or meadow for some years past. If it is to continue in grass, it should no longer be called arable. In England and Wales at one period, much of such land was kept in the arable class for a decade or more after it had ceased to rotate from tilled crop to grass. The standard form calls for classifying such land as arable for only four years after its last ploughing and as permanent meadow or pasture after it has been in ... years. This is too short a period for some of the rotations in which alfalfa and similar forage crops are grown; but apparently the world census planners assume that land in grass for five years or more in a ... hay most of the time, and hence is more properly classed as meadow than as arable. The term arable, it must be kept in mind, means ploughed or tilled, not tillable or cultivable.

In intensively-farmed countries like those of southern Europe, one finds much intermingling also of tilled crops and fruit or nut trees or bushes—"two-story agriculture." In this case, the world census asked to have the division of the area estimated, and if this was not possible, that it be classified according to its chief object.

The remaining land-use classes in the world census are "productive marshlands, heathlands and other productive but uncultivated lands," and "unproductive lands." The first of these seems precisely to take care of a good deal of land that was never "improved" but furnishes grazing, wild hay, berries and other ... fruits.

Seventeen countries adopted the ... as outlined, and ... adopted it with modifications. The principal variations were those found in the censuses of the United Kingdom, Denmark, Norway and India, in which "cultivated land," or "land in crops and grass" were not reported into arable, permanent meadow and grass, and trees and shrubs, and that of the United States and Australia, in which cropland and pasture are the two sub-classes, and trees and shrubs are included in cropland.

**Crops.**—The classification of crops outlined for the 1930 census was as follows: cereals harvested for grain, legumes for grain, tuber and root crops for food or forage, cultivated hay and forage crops (that is, grown in a rotation system), crops for industrial use, vegetables, crops grown for seed, crops sown but not harvested in the year of the census, fallow land, permanent meadow and grass, vineyards, ... orchard fruits and nuts, small fruits, and miscellaneous ... (including coffee, tea, cacao, pepper, chinchona, rubber, ..., sago palms, etc.). Under these heads, more than 100 different species of plants were listed, and others were provided for under such headings as "other vegetables," "other fruits and nuts." A major ... introduced by the growing of two or more crops in the ... one year, or ... two crops on the same land at the same time. The ... were, in the first case, to enter the areas of the later crops in brackets on the same line, and in the second, to divide the acreage if possible, and, if not, to list the combinations on separate lines.

Needless to state, the various countries introduced a great many variations on their schedules. Most of them, however, were details under the headings named. For example, 36 vegetables were listed separately in one country or another, in addition to the 9 in the standard form, and 8 tuber or root crops in addition to the 9 in the standard form.

**Livestock.**—Nine species of livestock, including bees, were listed in the general form, and 10 more in the supplementary questions (including camels, llamas, reindeer, ..., buffaloes, ostriches, foxes, skunks and rabbits). The principle ... was that of age classification. The general system adopted was that of one class to include animals born recently enough so that they measure the reproduction of the year past, or the last gestation period—like calves under 1 year, and pigs under 6 months, another class for female breeding stock, and another for male breeding stock. For poultry, only total numbers were asked for. Most of the countries adopted this system of classification, but some of them introduced more detail. For example, 26 of them, including the United Kingdom and the United States, listed cattle 1 to 2 years separately, and 16 of them listed ... chickens separately. It was apparent that even with these age ... the difficulty introduced by taking the census at different times of the year in the different countries was met only in part. Supplementary estimates of maximum and minimum would help, but were difficult to obtain.

**Production.**—The standard form in both world censuses asked for quantity produced as well as acres of crops and livestock numbers. Half of the purposes which agricultural statistics serve require data on production. Nevertheless, only 31 of the 46 countries reported production of annual crops, and fewer reported production of orchard fruits. Only 29 reported production of milk, butter and cheese, and 21 the production of eggs. These results followed even though the alternative procedure was allowed if necessary of estimating production by multiplying acres and numbers of productive livestock by yields per acre and per animal. Clearly the international Food and Agriculture Organization has a large task ahead before it will be able to measure the food supply and nutrition levels of large sectors of the world's population.

**Other Subjects.**—Of the remaining subjects covered in the supplementary questions, farm machinery called forth the largest response. Not only did more than 30 countries collect data on the six types of machines named in the schedule, but many of them listed additional types or subtypes—for example, nine kinds of power machines. Only a limited number supplied data on the acreage of land drained or irrigated, but most of these included additional details. Most of the countries limited their census of woodland to land within agricultural holdings. Nine, however, all but one in Europe also included independent forest holdings. Also eight countries followed the standard form in asking for a report on woods cut every few years, usually referred to as coppice in the enquiries. Only 15 asked for a report on the quantity of wood cut for fuel, pulp and other purposes. Finally, five European countries collected data on the total area of ponds stocked with fish and fish production.

Tenure systems are exceedingly varied, and the attempt in the supplementary questions to fit all farm land into the categories of owner-operated, cash-rented, share-rented and managed was not very successful, only 19 following the schedule outlined.

It would be a serious error to adjudge the scope of agricultural censuses by the subjects considered wise to include in world censuses. Other important subjects included in some enquiries are farm buildings and transport and communication; farm population: age, nationality and race of the farm operator; value of farm property, value of products raised or sold, farm expenses, farm income, farm debt and membership in farm co-operatives. The United States, France and some of the British dominions took the lead in expanding the census to include economic and other social information.

It would also be a serious mistake to judge the adequacy of world statistics on agriculture by the contributions of the 63 countries to the first world census. First of all, several countries, like the U.S.S.R., had other methods for keeping a running inventory of agriculture. Second, a considerable list of countries had taken censuses of a sort one time or another, but could not arrange to take one in 1930. Finally, most countries have official statistics or records that furnish a rough measure of agricultural developments.

Most agricultural censuses begin with a simple counting of farms, livestock and acres in different crops. A majority of the censuses of agriculture by the time of World War II were still in this counting

stage. While still in this stage, however, the number of items can be expanded considerably to include land use, workers, farm machinery, and more details as to crops and livestock The second stage of development is the inclusion of data on production The third step adds values and prices to the crop and livestock production, and to farm equipment and livestock If farm expenditures are then added, it becomes possible to estimate the gross value of agricultural production, and gross and net farm income, which can be included in estimates of the national income. Only a limited number of countries had reached this stage by 1944.

(For agricultural statistics of various countries, *see* the individual articles on those countries; likewise for states, provinces and other geographical divisions; *see* also AGRICULTURAL STATISTICS) (J. D BL)

**AGRICULTURE, CHAMBERS OF.** The Central Chamber of Agriculture in Great Britain was founded in 1866 simultaneously with the formation of local chambers in the country. These were combined into one association, known as the Central and Associated Chambers of Agriculture. The objects of the Association are to promote the interests of agriculture, and with that view to watch over all measures affecting agriculture both in and out of parliament, and to take such action thereon as may seem desirable in its interests. The scope of the association has widened, and it now comprises not only chambers and farmers' clubs, but agricultural societies, unions, federations, dairy associations and other agricultural institutions. Its aim is to form a common centre for all the different sections and groups in the industry. The work of the chamber is governed by a council of twenty-four members chosen by the subscribing members of the central chamber, and about 70 deputies appointed annually by the various federated bodies.

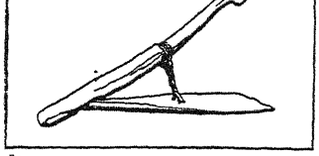
**AGRICULTURE, DEPARTMENT OF:** *see* GOVERNMENT DEPARTMENTS.

**AGRICULTURE, ELECTRICITY IN:** *see* RURAL ELECTRIFICATION

**AGRICULTURE, INTERNATIONAL INSTITUTE OF:** *see* INTERNATIONAL INSTITUTE OF AGRICULTURE

**AGRICULTURE, PRIMITIVE.** Agriculture (cultivation or tillage of the ground for the production of plants for food) is the basis of civilization, and primitive agriculture marks the transition from the lowest cultural stage, commonly called savagery. When and where, how and why were the first steps taken? No simple answer can be given. As to the date and place, a few hints are given by archaeology, but where primitive agriculture is now established there is rarely even a tradition of its origin. "God Almightie first planted a garden" is the general belief, God being represented by Osiris in Egypt, King Kintu in Uganda, Sidi or Soidi in Torres Strait, Ofanu in Tahiti, Tupan in Brazil, and by all the other local culture-heroes who brought the good gifts to men. As to the how and the why, information must be sought in areas where beginnings are being made.

There is as yet no cultivation of the soil or raising of crops in the Arctic regions, in the semi-desert regions of north and south Africa and Arabia, the high plateaux of Tibet and Mongolia, or the whole of central Australia. It is unknown also in certain jungle areas inhabited by groups of pygmy peoples, such as the Negrilloes of the Congo, the Andamanese, the Semang of the Malay peninsula, and there is no record of it among the extinct Tasmanians.



AN EGYPTIAN HOE FOUND AT THEBES USED IN THE NILE VALLEY ABOUT 2,000 B.C.

The first steps have been noted in various parts of the world. In Western Australia a species of flag was cultivated to the extent of burning down the crop at the end of the season to improve the next crop. Also, when digging up yams, the natives replaced the heads in the holes. Purslane (*Portulaca*) was also encouraged if not artificially cultivated. The Besisi of the Malay peninsula used to carry fruit they were eating to fresh spots so that the seeds might spread over the country. In Arizona a company of Cocopa, Mohave or Pima women, safely guarded by a number of men, set forth to a rich and favourable spot on the side of a cañon. Each woman has a little bag of gourd seed, and she plants these, one by one, in rich crannies or crevices where the roots can find sustenance, the sun may shine in, and the fruit may later swing down, as from a trellis. The planters go home and take no further notice of their vines until they return in the autumn to collect the gourds In manioc areas, the natural means of procuring food is still by hunting. Cassava forms a useful alternative, and when game is scarce or hunting unsuccessful, manioc culture increases in importance, yams, beans, peas, pumpkins and maize being added to the crops, while if hunting fails altogether, the group perforce turns to agriculture. Examples are common in the Congo region Similarly compulsion turns pastors into agriculturalists. In Africa the women have no share in cattle tending and are often mainly occupied in cultivating the crops of maize and vegetables. Should war or disease cause the herds to dwindle, or encroachments diminish the extent of the pasturage, the necessity for agriculture is increased until it absorbs the whole community. Sometimes the stimulus is given by political pressure, as in the case of the Bashkir Tatars, whose pasture lands were encroached upon by Russians to the north and west, and by the Ural Cossacks to the east, so that they could no longer support flocks and herds in sufficient numbers. Sometimes, however, although the first steps are taken, progress goes no farther, as in the wild rice districts of North America in the neighbourhood of the Great Lakes. Most of the Indians who had access to the rice fields collected the rice, ate it at every meal until it was finished, and then turned to other sources of food. There was a common belief that if any seed were sown no more would ever grow wild, and while food was plentiful and space and game were abundant, no further steps were taken.

**Assartage.**—In tropical or semi-tropical countries the common method of agriculture is assartage or essartage (from Lat. *exsartare*, to grub up trees and bushes from forest land to make it arable). For example, in South America a tract of specially productive forest land is chosen as a site for a maize field, smaller trees and undergrowth are cut down at the end of the rainy season, except those of greater size or of very hard wood, and the fallen masses, dried by sun and air for a few weeks, are then fired. On this charred surface, among half-burnt branches and blackened trunks, the maize is planted in holes a few feet apart and when it reaches the surface the Indian clears and stirs the ground with the hoe. Immediately after harvest the ground is prepared for a fresh crop, which, however, yields much less, and the clearing is then abandoned for several years. It soon becomes overgrown with weeds and undergrowth, and after a time, if no virgin land can be had, these will be burnt down and the land replanted as before; but the crops are poor, the soil is exhausted, the ashes of the undergrowth have not sufficient fertilizing value, and the clearing is finally abandoned. The burning of the felled trees enriches the land, and the same clearing can be used two, three or more times, but is less and less productive each season, so that new land is prepared and the cropped piece left fallow. The system is practised wherever space permits.

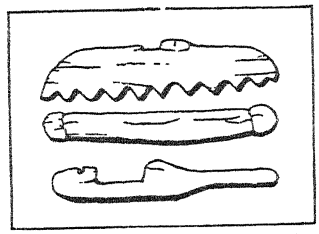
In Torres Strait each family has its patch of garden land marked out within the tribal area by definite boundaries. The limit may be marked by standing trees but more commonly the boundary is a ridge of earth, formed by the weeds and refuse thrown on the edge in the process of clearing the land. Every year a man clears a new piece of land and lets another portion lie fallow. The men cut down the larger trees, formerly with shell axes, while the women attack the undergrowth. There is no regular rotation of crops; usually the same plants (yams, bananas, sweet potatoes or sugar-cane) are planted in the same patch; only, as the crops deteriorate after one, two or three years, the land is allowed to lie fallow until the undergrowth is four or five years old, when it is cleared again. There are special names for gardens of successive ages. A newly cleared patch is *kerkar gedub* (new garden), next year it is *keas gedub*, and after two years *gazag gedub*. *Keas* and *gazag* gardens are not replanted, though sugar-cane and bananas continue to bear. (Torres Strait Reports, iv. 145–151.) Extensive agriculture (clearing a fresh patch every season) may go on as long as there is sufficient land, either virgin land still uncleared or overgrown fallow worth clearing; but where, owing to limitations of land or increase of population or

other economic influences, more crops or better crops are required and the exhausted land cannot restore itself, artificial restoration must be applied. Extensive agriculture becomes intensive.

Agriculture is everywhere associated with magic and religious ceremonies to ensure fertility, but artificial fertilization of a more practical nature is not unknown to primitive gardeners Mariner describes it in Tonga in 1827; powdered pumice was used in the Gilbert isles; human manure was a marketable commodity in Mexico, as in China In America artificial manuring was found from Nova Scotia to Chile. Fish was commonly planted in the maize hills with the seed and guano was carefully collected. In Peru extensive cultivation was impossible from lack of space, and crops were restricted to the pockets (*bolson*) of rich soil, formed from detritus washed down by the mountain torrents, enriched with mineral deposits from volcanic rocks. These natural plots were enlarged by irrigation streams which were also fertilizing. The guano beds of Peru were highly valued; they were the property of the different provinces, and the breeding places of the birds were protected by law.

**Irrigation.**—Leading an artificial stream on to a patch of land, to provide water for a crop varies from the hollowed tree-fern trunk which the Fijian lays down to supply his taro bed, to the imposing engineering works of the primitive agriculturalists of Peru, or the miles of aqueducts of ancient Ceylon. The sources of water may be natural rivers or lakes, artificial canals, reservoirs or underground supplies, and there are many contrivances for directing it over the land to be watered. Water from a higher level is led off in narrow mud-banked channels which can be stopped or diverted merely by blocking up or breaking down a channel wall here and there. If the water has to be raised, a man may sit by the side of a stream with a half gourd or coco-nut (now-a-days often a kerosene tin) fixed to a stick, ladling out the water and pouring it on to his crop. In deep water a bucket is lowered by means of a rope and drawn up to the surface. The *shaduf*, characteristic of Egypt, and widely distributed from West Africa to the East Indies, consists of a forked pole stuck in the ground, with a long pole balancing on the fork, its heavier end on the bank, and the lighter end, with a bucket attached, over the water. The bucket is lowered into the water, and, when full, the heavy end of the pole helps to raise it. Water can thus be raised 10 or 15ft., and a succession of *shadufs* can raise it to any height required. When there is running water, a water-wheel with buckets on an endless chain is common in the Old World, or the wheel may be turned by animals or men. Where the underground supply of water is very deep, as in parts of India or in the Sahara, a pit is dug, walled in with masonry, and a skin bag lowered over a pulley by long ropes to a depth of 100 or 200ft. The ends of the ropes are attached to bullocks, mules, donkeys, camels, women or slaves, who walk down a slope equal to the depth of the wall. Neither the *shaduf*, the water-wheel or the pulley was used in the New World, but there are extensive irrigation works in the drier Pueblo region, especially Arizona, where 150 miles of ancient irrigation ditches may be traced. In Mexico and Peru extensive engineering works prove the care given to irrigation. Channels were carried round the sides of mountains and even tunnelled through them; so that the waters of the higher valleys where the supply was abundant were made available for the cultivation of others where it was deficient; and these channels were made to irrigate not only the cultivated fields but the llama pastures on the mountain sides.

**Terrace Cultivation.**—In clearing sloping land for planting, trees are felled, stones are collected or undergrowth and weeds heaped up all along the edges of the space to be planted, and ridges and terraces are thus formed. The discovery of their value for preserving moisture and preventing erosion on slopes would easily lead to the artificial terracing so widely distributed throughout the Old and New Worlds. Terrace cultivation is imposed on agriculture by political, geographical, climatic or economic influences. An agricultural group is by its nature exposed to attacks which, by its nature, it is unable to resist except by retreat to a naturally fortified or easily defended position; and this is provided by the hills, where every patch must be carefully preserved and augmented. Artificial banks are therefore raised to prevent further erosion, and, if necessary, loads of earth are retrieved from the valleys Such is the precarious agriculture of the Man Tze, or "untameable worms," as the aboriginal inhabitants are called by their Mongol [illegible] who forced them to retreat into the mountain fastnesses of the Yangtse valley, where, at a height of about 10,000ft. above sea-level, they perch their villages on the steep cliffs. The back of the house is burrowed out of the rock face, the front is supported on a platform, resting on beams; the approach is by steps made of bolts driven into the rock, and small children are tethered to the door-posts to prevent them from falling over the edge. Here in little patches between the rocks every inch of soil is carefully tilled and crops are raised though the only access to the terrace may be by a rope (I. B Bishop, *The Yangtse Valley and Beyond*, 1900) Both archaeology and history show evidence of early terracing round the Mediterranean and in Britain during the Bronze Age

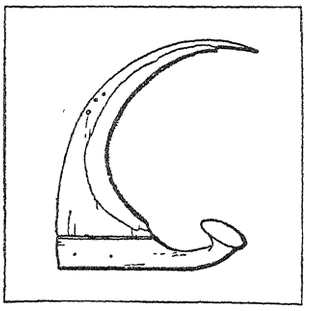


BY COURTESY OF THE METROPOLITAN MUSEUM OF ART
A PRIMITIVE EGYPTIAN RAKE OF THE XXth DYNASTY FOUND AT LISHT

In hilly and mountainous districts where the rainfall is insufficient or irregular, terrace cultivation and irrigation go hand in hand The water from a mountain stream is easily directed down the slope, and the embankments of the terraces preserve the moisture, so this method is universal on the drier slopes throughout the world The Arabs in Yemen give the best example Here the mountains are terraced from their base up to sometimes as high as 6,000ft , with terrace walls from 5ft. to 15ft. high. Reservoirs filled in the two rainy seasons supply the streams for the irrigation channels. When, in the 10th century, the Arabs reached Spain, they converted every mountain slope into a succession of green terraces. In the mountain areas of India, in Ceylon, in Tibet and in China, terrace cultivation can be seen on a large scale. The Chinese, farmers of 40 centuries, carry terracing to a fine art. In densely populated neighbourhoods every inch of soil is of value; it is collected in baskets in the valleys, carried up the barren hill slopes, and embanked, forming astonishingly productive gardens. Examples are rare in the New World, but in Peru the same necessities were met by the same device, and hundreds of terraces one above the other rose from the valleys to the utmost cultivable limit. These were extended year by year by communal labour, and produced the finest crops of potatoes and maize, eliciting the astonished admiration of Cortes: "There was not a span that was not cultivated" Increase of population and of civilized wants, with the growing importance of food-crops or drink-crops, lead to the intensive cultivation seen in the mountain zone of Europe; in Switzerland, for example, or the Moselle and Rhine valleys, in the Vosges and Black Forest, in the Suabian Jura, in Italy, up the slopes of the Apennines or the Ligurian Alps, and in the "desperate agriculture" of Teneriffe, where camels laden with earth bring soil for the gardens almost daily into the town of Santa Cruz.

**Implements.**—The primitive implement is everywhere the digging stick, usually merely a strong stick, with one end pointed or flattened (a rudimentary spade) and often hardened in the fire. This is used for digging up roots by people who do not cultivate the soil, such as the Australians or the Bushmen of South Africa. The Bushmen weight their digging sticks with a heavy perforated stone whorl which acts as a lever. The digging stick or *ô* in use in Tahiti nearly a century ago was originally a stick sharpened at the point and hardened by charring at the end; but when iron was obtained, a narrow sharp piece like a chisel was fixed at the end, and as much of the ground was stony, this was found very convenient. No use was made of the foot in thrusting the spade into the soil, but the digger assumed a crouching attitude, piercing the ground and breaking up the earth by the strength of hands and arms (Ellis, *Polynesian Researches*, p. 137–138). In Fiji the grass, reeds and undergrowth were broken down by a sharp-edged club. The digging sticks (poles with one end flattened) are used by three or four men encircling a large clod which they lever up. The women, fol-

lowing on their knees, pulverize this with their hands. A hoe, made of turtle shell or an oyster valve, was used for weeding. A knife has now replaced the club, but as a spade is painful to bare feet, the digging stick holds its place, though its power is now increased by an iron blade. In New Zealand the Maori lashed on a foot-piece at right angles to the digging stick; in Peru a foot-rest is bound on with leathern thongs, and, higher up, another rest is attached in the same way; this is for the left hand, which assists the foot in applying the weight of the body to the thrust. Similar types are found from New Mexico to Chile. The *caschrom,* still used in the stony patches of the Shetlands and the Hebrides, is a larger and more elaborate digging stick, with its end shod in iron and a foot-rest attached. The hoe is really a pick, with the digging end flattened. The simplest form is a piece of wood, with a natural angle, usually part of the trunk and a projecting branch, or two pieces of wood fastened together. The former is illustrated in Europe in the Swedish "hack" and the latter was characteristic of ancient Egypt. In North America a bent piece of wood, the shoulder blade of elk or bison, or a piece of tortoise shell is fastened to a handle, but the hoe was rare in America except in the eastern maize area. African hoes are of iron, often set at an acute angle to the shaft, this and the shortness of the handle necessitating a crouching position when hoeing. The size and shape of hoes in Nigeria reflect the variation of soil, a gradation being traced from the sandy soils of the north to the heavier land of the south. There is little doubt that women were the earliest agriculturists. Even when the harder labour of clearing the ground is done by men, planting, sowing, tending and collecting are women's work. "When the women plant maize," said the Indians, "the stalk produces two or three ears. Why? Because women know how to produce children. They only know how to plant corn to ensure its [illegible] Then let them plant it. They know more than we do" (J. P. Acosta, *History of the New World,* ii, 7.) The fact that the cereal deities of the old and new worlds were usually female strengthens the view that the cultivation of plants is one of women's contributions to civilization.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A STONE SICKLE OF THE TYPE USED IN EGYPT 4,000 YEARS AGO RECONSTRUCTED FROM FRAGMENTS DISCOVERED AT THEBES

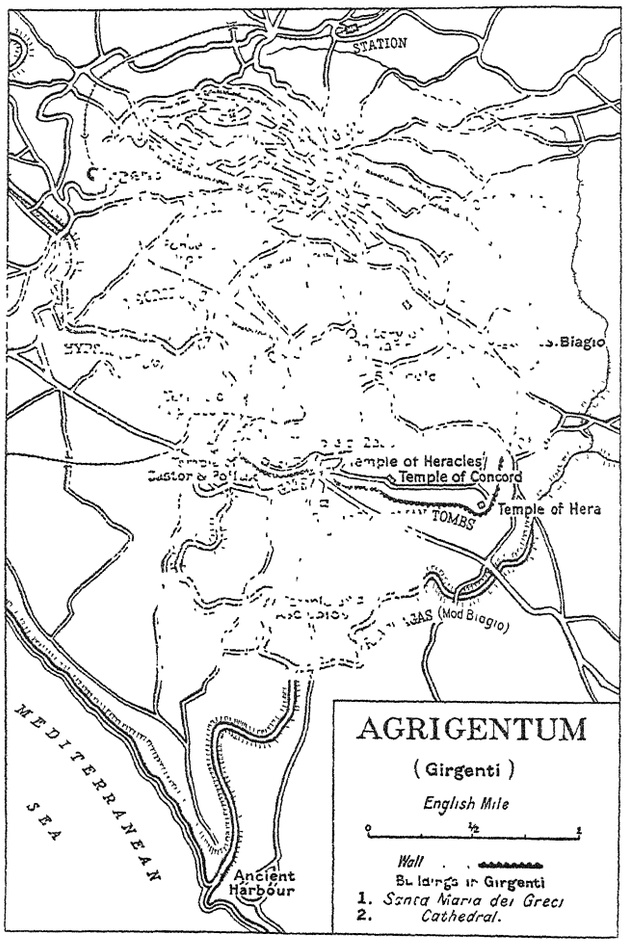
BIBLIOGRAPHY.—*See* E. J. Payne, *History of the New World Called America* (1892); O. T. Mason, *The Origins of Invention* (1895); Harold Peake, *The Origins of Agriculture* (1928); E. E. Edwards and W. D. Rasmussen, "A Bibliography on the Agriculture of the American Indians," U.S. Department of Agriculture, *Misc. Pub. 447* (1942).

(A. H. Q.)

**AGRICULTURE, TROPICAL:** *see* TROPICAL AGRICULTURE.

**AGRI DECUMATES,** "tithe lands" given by the Romans to Gallic settlers, and also to Roman veterans on the payment of a rent of a tenth (*decuma*) of the produce, on the east of the Rhine. (*See* LIMES GERMANICUS.)

**AGRIGENTUM** (Gr. Ἀκράγας, mod. AGRIGENTO), ancient city, south coast of Sicily, 2½m. from the sea. Founded by Greek colonists from Gela as late as 582 B.C., its favourable site for cultivation and trade with Carthage made it second only to Syracuse. Pindar calls it καλλίστα βροτεᾶν πολίων (fairest of mortal cities). Ruled at first by tyrants, in 472 a democracy was established. In the struggle between Syracuse and Athens (415–413) the city remained neutral. Its prosperity continued to increase (its population is given at over 200,000) until in 405 B.C. it was captured and plundered by the Carthaginians, a blow from which it never entirely recovered. It was colonized by Timoleon in 338 B.C. with settlers from Velia in Lucania, and in the time of the tyrant Phintias (289–279) it had regained some of its power. In the first Punic War, however, it was sacked by the Romans (261) and the Carthaginians (255), and finally in the second Punic War by the Romans (210). Still in the Roman period, it exported agricultural products, textile fabrics and sulphur. In the local museum are tiles used for stamping cakes of sulphur, which show that the mines, at any rate from the 3rd century A.D., were imperial property leased to contractors. The site is unusual and beautiful with a lofty ridge with two summits to the north. On the western summit is the modern town (985ft.), the eastern summit slightly higher, bears the name of Rock of Athena, owing to its identification by some scholars with the acropolis of Acragas as described by Polybius, who places upon it the temple of Zeus Atabyrius (said to have been erected by the half-mythical Phalaris) and that of Athena. The available space about 70 x 20 yds.) on the eastern summit is, however, too small. In the modern town, on the other hand, the remains of one temple are to be seen in the church of Sta. Maria dei Greci, while the other is generally supposed to have occupied the site of the cathedral. On the north both summits are defended by cliffs, on the south the ground slopes away somewhat abruptly from the eastern summit towards the plateau on which the town stood, while the western summit is separated from this plateau by a valley traversed by a branch of the Hypsas (mod *Drago*), the deep ravine of which forms the western boundary and defence of the city. On the east is the valley of the Acragas (Fiume S. Biagio). The church of S. Biagio, above it, is built into the temple of Demeter which was preceded by a sanctuary in the cliffs. The Acragas defends the approach from the east and the deeper Hypsas that from the south-west. They unite south of the town and flow out in the small abandoned harbour. A row of important Doric temples crowns the southern slopes; they are built of the local porous stone, which is of a warm red brown colour, full of fossil shells and easily corroded when exposed to the air. Of all these temples the oldest is probably that of Heracles (eight columns of which have recently been re-erected)



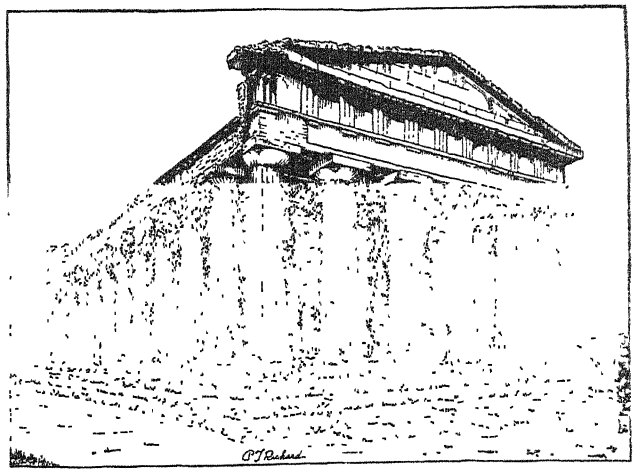
DIMENSIONS OF TEMPLES AT AGRIGENTUM

| | Demeter. | Hera Lacinia (so called) | Concordia (so called). | Heracles | Zeus. | Castor and Pollux (so called) | Unnamed near Castor and Pollux | Hephaestus (so called). | Asclepius. | Athena (so called). |
|---|---|---|---|---|---|---|---|---|---|---|
| Length including steps* | 99 | 125 | 129½ | 220 | 361 | . | | | . | .. |
| Breadth | 43½ | 55½ | 55½ | 85 | 173½ | | 67¼ | 51½ | 30½ | 45 |
| Length of cella . | 65 | 93 | 96½ | 156 | 332 | 91 | . | | .. | .. |
| Breadth of cella . . | 43½ | 32½ | 31½ | 45¼ | 144¼ | 33 | | .. | .. | .. |
| Height of columns with capitals | .. | 21 | 22 | 33 | 62½ | 19¼ | .. | .. | .. | .. |
| Diameter of columns at bottom . | .. | 4½ | 4½ | 6¼ | 14 | 4 | .. | 5 | 3⅓ | 4⅔ |
| Original number of columns . . | .. | 34 | 34 | 38 | 38 | 34 | .. | | | .. |
| Class . . . . | In antis | Peripteros hexastylos. | Peripteros hexastylos. | Peripteros hexastylos | Pseudo-peripteros hepta-stylos. | | .. | Peripteros | Prostylos pseudo-peripteros. | Peripteros |
| Approximate date . | 500 B.C. | 460 B.C. | 440 B.C. | 510 B C | 450 B.C | 338–210 B.C. | | After 338 B C. | Before 210 B.C. | 488–472 B.C. |

*Dimensions in English feet.

while the best preserved are those wrongly attributed to Hera and Concordia, which are very similar in dimensions; the latter, indeed, lacks nothing but its roof, owing its preservation to its conversion into a church in 597 by Gregory II., bishop of Girgenti. These temples are among the finest in existence In front of the former, as in front of those of Heracles and Zeus, stood a huge altar for burnt offerings, as long as the façade of the temple itself. The *cella* of the temple of Heracles was modified in Roman times, and a statue of Asclepius seems to show change of cult.

In the colossal temple of Zeus the huge Atlantes (figures of Atlas), 25ft. in height, are noticeable. They seem to have stood in the inter-columniations half-way up the outside wall and to have supported the epistyle. The collapse both of this temple and of that of Heracles must be attributed to an earthquake; many fallen blocks of the former were removed in 1756 for the construction of the harbour of Porto Empedocle. The four columns



THE TEMPLE HERE SHOWN WITH ALL ITS COLUMNS STILL IN SITU, WHICH HAS BEEN WRONGLY ATTRIBUTED TO CONCORDIA, IS THE BEST PRESERVED OF THE NUMEROUS AND SPLENDID RUINS STILL TO BE FOUND ON THE SITE OF THE CITY OF AGRIGENTUM. IT OWES ITS PRESERVATION TO GREGORY II. BISHOP OF GIRGENTI

erected on the site of the temple of Castor and Pollux are a modern (and incorrect) restoration in which portions of two buildings have been used. Of that of Hephaestus only two columns remain, while that of Asclepius, a mile to the south of the town, an anta and two pillars are preserved. Other remains are unimportant. Near the picturesque church of S. Nicolo is the so-called oratory of Phalaris, a tomb of the 1st century B.C., 27¼ft. by 23⅓ft., and not far off on the east are two private houses of the Roman period. The fishpond (circumference said by Diodorus to be 7 stadia) is an enormous excavation south-west of the city, with drains in its sides; the bottom is now an orange garden.

The wall line can be traced, but actual remains are small except in the valley below the temple of Demeter (S. Biagio). East and west ravines gave protection, so a massive wall was unnecessary, while near the south-east angle a breastwork was formed by the excavation of the natural rock, in later times honeycombed with tombs Close to this temple on the west is the site of the gate known in later times as the *Porta Aurea*, through which the modern road passes.

Tombs of the Greek period have been found mainly on the west of the town, outside the probable line of the walls, between the Hypsas and a small tributary, the latter having been spanned by a bridge, now called *Ponte dei Morti*, of which one massive pier, 45ft. in width, still exists. Just inside the south wall is a Christian catacomb, and outside it a tomb in two storeys, a mixture of Doric and Ionic architecture, belonging probably to the 2nd century B.C. A village of the Byzantine period has been explored at Balatizzo, immediately to the south of the modern town. The walls of the dwellings are entirely cut out of the natural rock.

The modern town, known as Girgenti till 1928 but then reverting to the older form of Agrigento, is the capital of the province of Agrigento, and an episcopal see, 58 mi. S by E. of Palermo direct and 84½ mi. by rail. Pop. (1936) 27,785 (town), 32,951 (commune). The cathedral occupies the highest point in the town; it was founded in the 13th century and there are other remains of architecture of this period. The museum contains fine vases, terra cottas, sculptures, etc. Porto Empedocle, pop. (1936), 13,834 (town), 14,764 (commune), 5½ mi. S. by rail, is connected with Castelvetrano, on the line from Palermo to Trapani. It is the principal port for the shipment of sulphur, the mining district lying just north of Agrigento, and was heavily bombed by the Allies during World War II after their victory in North Africa. (T. A.; X.)

**AGRIMONY,** a slender perennial herb (botanical name, *Agrimonia Eupatoria*, family Rosaceae), 1½ to 3 ft. high growing in hedge-banks, copses and borders of fields. The leafy stem ends in spikes of small yellow flowers. The flower-stalk becomes recurved in the fruiting stage, and the fruit bears a number of hooks which enable it to cling to rough objects, such as the coat of an animal, thus ensuring distribution of the seed. The plant is common in Britain and widely spread through the north temperate region. The underground woody stem is astringent and yields a yellow dye.

The name has been unsystematically given to several other plants; for instance: bastard, Dutch, hemp or water agrimony (*Eupatorium cannabinum*); noble or three-leaved agrimony (*Anemone Hepatica*); water agrimony (*Bidens*); and wild agrimony (*Potentilla Anserina*).

**AGRIOLOGY** is the science of the prehistoric human practices and ways of living, especially those pertaining to the key-factors of existence, food, shelter and clothing.

**AGRIONIA,** an ancient Greek festival, celebrated annually at Orchomenus in Boeotia and elsewhere, in honour of Dionysus Agrionius ("the wild") by women and priests at night. The tradition is that the daughters of Minyas, king of Orchomenus, having despised the rites of the god, were seized with frenzy and ate the flesh of one of their children. At this festival it was originally the custom for the priest of the god to pursue a woman of the Minyan family with a drawn sword and kill her. (Plutarch, *Quaest. Rom.* cii, *Quaest. Graecae,* xxxviii.)

**AGRIPPA,** a sceptical philosopher, whose date cannot be accurately determined. He must have lived later than Aenesidemus. To him are ascribed the five tropes (*πέντε τρόποι*) which, according to Sextus Empiricus, summarize the attitude of the later ancient sceptics. (1) Since some thinkers hold that nothing is known but the sensible; others that nothing is known but the intelligible, it follows that the only wise course is neither to affirm nor to deny. (2) The proof of one so-called fact depends on another fact which itself needs demonstration, and so on *ad infinitum.* (3) The data of sense are relative to the sentient being, those of reason to the intelligent mind; that in different conditions things themselves are seen or thought to be different. Where, then, is the absolute criterion? (4) All knowledge depends on certain hypotheses, or facts taken for granted. Such knowledge is hypothetical. (5) The fifth trope points out the impossibility of proving the sensible by the intelligible inasmuch as it remains to establish the intelligible in its turn by the sensible. Such a process is a vicious circle and has no logical validity. A comparison of these tropes with the ten tropes enumerated in the article AENESIDEMUS shows that scepticism has made an advance into the more abstruse questions of metaphysics. The first and the third include all the ideas expressed in the ten tropes, and the other three systematize the more profound difficulties which new thinkers had developed.

*See* Diogenes Laertius x. 88, and Zeller's *Greek Philosophy.* Also the articles SCEPTICISM, AENESIDEMUS.

**AGRIPPA, HEROD I.** (*c.* 10 B.C.–A D. 44), king of Judaea, the son of Aristobulus and Berenice, and grandson of Herod the Great, was born about 10 B.C. His original name was Marcus Iulius Agrippa. Josephus informs us that, after the murder of his father, Herod the Great sent him to Rome to the court of Tiberius, whose son Drusus became his friend. On the death of Drusus, Agrippa, who had been recklessly extravagant, was obliged to leave Rome overwhelmed with debt. After a brief seclusion, Herod the Tetrarch, his uncle, who had married Agrippa's sister Herodias, made him *Agoranomos* (Overseer of Markets) of Tiberias, and presented him with a large sum of money; but his uncle being unwilling to continue his support, Agrippa left Judaea for Antioch and soon after returned to Rome, where he was welcomed by Tiberius and became constant companion to the emperor Gaius (Caligula), then a popular favourite. Agrippa, overheard by his freedman Eutyches to express a wish for Tiberius' death and the advancement of Gaius, was betrayed to the emperor and cast into prison. In A.D. 37 Caligula, having ascended the throne, heaped wealth and favours upon Agrippa and gave him the tetrarchy of Batanaea and Trachonitis. To this he added that held by Lysanias; and Agrippa journeyed into Judaea to take possession of his new kingdom. In A.D. 39 he returned to Rome and brought about the banishment of Herod Antipas, to whose tetrarchy he succeeded On the assassination of Caligula (A.D. 41) Agrippa supported the emperor Claudius, who gave him the government of Judaea, while the kingdom of Chalcis in Lebanon was, at his request, given to his brother Herod. Thus Agrippa became one of the greatest princes of the east, the territory he possessed equalling in extent that held by Herod the Great. He returned to Judaea and governed it to the great satisfaction of the Jews. His zeal, private and public, for Judaism is celebrated by Josephus and the rabbis; and the narrative of Acts xii, telling of his persecution of the Apostles James and Peter, gives a typical example of it. Both the Acts of the Apostles and Josephus give an account of his sudden death after an exhibition of games at Caesarea. A third account says that Agrippa was assassinated by the Romans, who objected to his growing power. He had shown too independent a spirit in his attempt to strengthen the walls of Jerusalem and to summon a meeting of other client princes and after his death the emperor appointed no more kings of Judaea, but ruled the province by means of procurators

*See* articles Josephus, J A. 18 and 19 in *Ency. Bibl.* (W. J. Woodhouse), *Jewish Ency.* (M. Brann), with further references; N. S. Libowitz, *Herod and Agrippa* (2nd ed., 1898), Gratz, *Geschichte d Juden,* iii. 318–361.

**AGRIPPA, HEROD II.** (27–100), son of Agrippa, Herod I., and like him originally Marcus Julius Agrippa, was born about A D. 27, and received from Claudius the tetrarchy of Chalcis and the oversight of the Temple on the death of his uncle, Herod, A D. 48. In A.D. 53 he was deprived of that kingdom and given other provinces instead. He tried to prevent the Jews from rebelling, and when war broke out sent auxiliaries to help the Romans. He died in Rome in A D. 100. He was the seventh and last king of the family of Herod the Great. It was before him and his sister Berenice (*q v.* B.2) that St. Paul pleaded his cause at Caesarea (Acts xxvi ). He supplied Josephus with information for his history.

**AGRIPPA, MARCUS VIPSANIUS** (63–12 B C ), Roman statesman and general, son-in-law and minister of the emperor Augustus, was of humble origin. He was of the same age as Octavian (as the emperor was then called), and was studying with him at Apollonia when news of Julius Caesar's assassination (44 B C) arrived. By his advice Octavian at once set out for Rome. Agrippa played a conspicuous part in the war against Lucius, brother of Mark Antony, which ended in the capture of Perusia (40). Two years later he put down a rising of the Aquitanians in Gaul, and crossed the Rhine to punish the aggressions of the Germans On his return he refused a triumph but accepted the consulship (37) At this time Sextus Pompeius, with whom war was imminent, had command of the sea on the coasts of Italy Agrippa's first care was to provide a safe harbour for his ships, which he accomplished by cutting through the strips of land which separated the Lacus Lucrinus from the sea, thus forming an outer harbour; an inner one was also made by joining the lake Avernus to the Lucrinus (Dio Cassius xlviii. 49; Pliny, *Nat. Hist.* xxxvi. 24). About this time Agrippa married Pomponia, daughter of Cicero's friend Pomponius Atticus. Having been appointed naval commander-in-chief he put his crews through a course of training, until he felt in a position to meet the fleet of Pompeius. In 36 he was victorious at Mylae and Naulochus, and received the honour of a naval crown for his services. In 33 he was chosen aedile and signalized his tenure of office by effecting great improvements in the city of Rome, restoring and building aqueducts, enlarging and cleansing the sewers, and constructing baths and porticos, and laying out gardens He also first encouraged the public exhibition of works of art. The emperor's boast that he had found the city of brick but left it of marble ("marmoream se relinquere, quan latericiam accepisset," Suet. Aug. 29), might with greater propriety have been uttered by Agrippa. He was again called away to take command of the fleet when the war with Antony broke out. The victory at Actium (31), which gave the mastery of the world to Octavian, was mainly due to Agrippa. As a token of signal regard Octavian bestowed upon him the hand of his niece Marcella (28). We must suppose that his wife Pomponia was either dead or divorced In 27 Agrippa was consul for the third time, and in the following year the senate bestowed upon Octavian the imperial title of Augustus. Probably in commemoration of the battle of Actium, Agrippa built and dedicated the Pantheum still in existence as *La Rotonda.* The inscription on the portico states that it was erected by him during his third consulship. His friendship with Augustus seems to have been clouded by the jealousy of his brother-in-law Marcellus, which was probably fomented by the intrigues of Livia, the second wife of Augustus, who feared his influence with her husband. In 23 B.C., Agrippa went as governor to the East, ruling by means of legates, while he himself remained at Lesbos. But the death of Marcellus, which took place in the same year, obliged the emperor to look

to Agrippa as his successor He was recalled to Rome, and to strengthen the tie between him and Augustus was made to divorce Marcella and marry the emperor's daughter Julia (21), the widow of Marcellus. In 19 he was employed in putting down a rising of the Cantabrians in Spain. In 18 B.C. he received the Tribunician power for five years, and in the following year a renewal of his command in the East, where his just and prudent administration won him the goodwill of the provincials, especially the Hebrew population. His last public service was the bloodless suppression of an insurrection in Pannonia (13). He died at Campania in March of the year following his 51st year. Augustus honoured his memory by a magnificent funeral.

Agrippa was also known as a writer, especially on geography. Under his supervision Julius Caesar's design of having a complete survey of the empire made was carried out. Amongst his writings an autobiography, now lost, is referred to. Agrippa left several children; by Pomponia, a daughter Vipsania, who became the wife of the emperor Tiberius; by Julia three sons, Gaius and Lucius Caesar (adopted by Augustus as his successors) and Agrippa Postumus, and two daughters, Agrippina the elder, afterwards the wife of Germanicus, and Julia, who married Lucius Aemilius Paullus.

*See* Dio Cassius xlix.–liv ; Suetonius, *Augustus;* Velleius Paterculus ii.; Josephus, *Antiq. Jud.* xv. 10, xvi. 2; Turnbull, *Three Dissertations*, one of the characters of Horace, Augustus and Agrippa (1740); Andresen, *Marcus Vipsanius Agrippa* (1836); Motte, *Etude sur Marcus Agrippa* (1872), Nissen-Landi, *Marcus Agrippa e i suoi tempi* (1901), D. Detlefsen, *Ursprung, Einrichtung und Bedeutung der Erdkarte Agrippas* (1906), Gardthausen, *Augustus und seine Zeit.* Vol. i. 762 foll., ii. 432 foll.

**AGRIPPA VON NETTESHEIM, HENRY CORNELIUS** (1486–1535), German writer, soldier, physician and by common reputation a magician. Agrippa was for many years in the service of Maximilian I., the German king, who sent him in 1510 on a diplomatic mission to England, where he was the guest of Dean Colet. From 1511 to 1518 he was in Italy in the service of William VI. of Monferrato and of Charles III. of Savoy. His interest in the occult sciences had brought him into conflict with the church at Dôle in 1509 when he lectured on John Reuchlin's *De verbo mirifico;* again at Pavia in 1515 when he lectured at the university on the *Pimander* of Hermes Trismegistus; and again at Metz in 1518, where he was town orator, for his defence of a woman accused of witchcraft. He then practised medicine in Cologne, Geneva, Freiburg and Lyons for short periods until Margaret, duchess of Savoy and regent of the Netherlands, appointed him archivist and historiographer to the emperor. Margaret's death in 1530 weakened his position, but after suffering a short imprisonment for debt at Brussels he lived at Cologne and Bonn, under the protection of Hermann of Wied, archbishop of Cologne. He then went to France, where he was arrested by order of Francis I. for some disparaging words about the queen-mother; but he was soon released, and on Feb. 18 1535, died at Grenoble. He was thrice married and had a large family. Agrippa's work, *De occulta philosophia,* which brought him into antagonism with the Inquisition, was written about 1510, partly under the influence of the author's friend, John Trithemius, abbot of Würzburg, but its publication was delayed until 1531, when it appeared at Antwerp. It is a defence of magic, by means of which men may come to a knowledge of nature and of God, and contains Agrippa's idea of the universe with its three worlds or spheres. His other principal work, *De incertitudine et vanitate scientiarum et artium atque excellentia Verbi Dei declamatio,* was written about 1527 and published at Antwerp in 1531. In it Agrippa denounces the accretions which had grown up around the simple doctrines of Christianity, and wishes for a return to the primitive belief of the early Christian church. He also wrote *De nobilitate et praecellentia feminei sexus,* dedicated to Margaret of Burgundy, *De matrimonii sacramento* and other smaller works. An edition of his works was published at Leyden in 1550 and they have been republished several times.

*See* H. Morley, *Life of H. C. Agrippa* (London, 1856); A. Prost, *Les sciences et les arts occultes au XVI. siècle: Corneille Agrippa, sa vie et ses oeuvres* (Paris, 1881); A Daguet, *Cornelius Agrippa* (Paris, 1856); J. Orsier, *H. C. Agrippa, sa Vie et son Oeuvre* (1911).

**AGRIPPINA**, the "elder," daughter of Marcus Vipsanius Agrippa (*q.v.*) by his third wife Julia, was the granddaughter of Augustus and the wife of Germanicus. She accompanied her husband to Germany, when the legions on the Rhine revolted after the death of Augustus (A.D. 14). Three years later she was in the East with Germanicus (*q.v.*), who died at Antioch in 19, poisoned, it was said, by order of Cn Calpurnius Piso, governor of Syria. Eager to avenge his death, she returned to Rome and boldly accused Piso of the murder of Germanicus. To avoid public infamy Piso committed suicide. Tiberius and his favourite Sejanus feared that her ambition might lead her to attempt to secure the throne for her children, and she was banished to the island of Pandataria off the coast of Campania, where she died on Oct 18, 33, starved to death by herself, or, according to some, by order of Tiberius. Two of her sons, Nero and Drusus, had already fallen victims to the machinations of Sejanus Agrippina had a large family by Germanicus, several of whom died young, while only two are of importance—Agrippina the "younger" and Gaius Caesar, who succeeded Tiberius under the name of Caligula. There is a portrait of Agrippina in the Capitoline Museum at Rome and a bronze medal in the British Museum, representing the bringing back of her ashes to Rome by order of Caligula.

*See* Tac. *Ann.* i.–vi ; Suetonius *Tiberius,* 53; Dio Cassius lvii. 6, lviii. 22, lix. 3; Elizabeth Hamilton, *Memoirs of the Life of Agrippina* (1804); Stahr, *Romische Kaiserfrauen* (1880).

**AGRIPPINA**, the "younger" (A.D. 16–59), daughter of Germanicus and Agrippina the elder, sister of Caligula and mother of Nero, was born at Oppidum Ubiorum on the Rhine, afterwards named in her honour Colonia Agrippinae (mod. Cologne). By her first husband, Gnaeus Domitius Ahenobarbus, she was the mother of the emperor Nero; her second husband was Passienus Crispus, whom she was accused of poisoning, in 49. After the death of Messalina, she married the emperor Claudius, her uncle, and induced him to adopt the future Nero as heir to the throne in place of his own son (Britannicus). In 54 she poisoned Claudius and secured the throne for her son. Being alarmed at the influence of the freedwoman Acte over Nero, she threatened to support the claims of the rightful heir Britannicus. Nero thereupon murdered the young prince and decided to get rid of his mother.

Pretending a reconciliation, he invited her to Baiae, where an unsuccessful attempt was made to drown her on a vessel especially constructed to founder. Eventually he had her put to death at her country house.

Agrippina wrote memoirs of her times, referred to by Tacitus (*Ann.* iv, 53).

*See* Tac. *Ann.* xii, xiii, xiv; Dio Cassius lix-lxi; Suetonius, *Nero,* 34; Stahr, *Agrippina, die Mutter Neros* (1880); Raffay, *Die Memoiren der Kaiserin Agrippina* (1884); B. W. Henderson, *The Life and Principate of the Emperor Nero* (1903); J. MacCabe, *Empresses of Rome,* ch. v (1911); also article NERO.

**AGRONOMY.** In the middle 1890s the term agronomy, used to designate the branch of agriculture dealing with climate, soils, fertilizers and crops (plant production), was introduced into the agricultural colleges and experiment stations of the United States. The term as now generally used indicates that branch of agriculture dealing with the science and the art of field crop culture and soil management. However, in some institutions the term agronomy is limited to the culture of field crops. (A. D. T.)

**AGUADILLA,** the largest and most important town in the northwestern section of Puerto Rico.

The population by the 1950 census of the town itself was 18,181 (1940, 13,468), while the population of the municipal district in 1950 was 43,748.

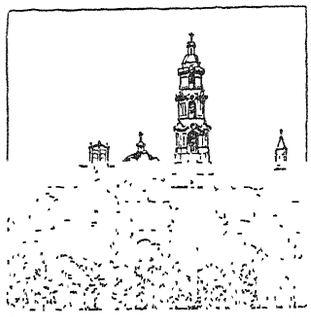
Aguadilla is situated on the west coast of Puerto Rico, on the Mona channel which connects the Atlantic ocean with the Caribbean sea. It is a seaport, but has little shipping. It is situated on the belt-line railroad which follows the coastal plains around the island and also has connection by well-built highways with the principal cities of the island.

Aguadilla has several industries and its business houses are well established. Its schools are superior, and an old church is of

especial interest.

According to tradition, Columbus' fleet of discovery in 1493 refilled its water casks at the fountain which still flows in the centre of the town. It is certain that Columbus landed in Aguadilla near the bank of the Culebrinas river. On this spot a magnificent marble cross has been erected to commemorate this historic event. There is no place under the U.S. flag on which Columbus landed except Puerto Rico. (H. M. T.; J. L.-EE.; X.)

**AGUASCALIENTES,** an inland state of Mexico, bounded north, east and west by the state of Zacatecas, and south by Jalisco. Pop. (1930) 132,900; (1940) 161,693. Area, 2,498 sq. mi. The state occupies a part of the plateau of central Mexico about 6,000 ft above sea level, extending from two spurs of the Sierra Madre, called the Sierra Fria and Sierra de Laurel, eastward to the rolling fertile plains of its eastern and southeastern districts. It is well watered by numerous small streams and one large river, the Aguascalientes or Rio Grande, and has a mild healthy climate with a light rainfall. The fertile valleys of the north and west are devoted to agriculture and the plains to stock raising Indian corn, flour, cattle, horses, mules and hides are exported to the neighbouring states. Mining industries are still undeveloped, but considerable progress has been made in manufactures, especially of textile fabrics. The state has good railway communications and a prosperous trade. The capital, Aguascalientes, named from the medicinal hot springs near it, is a flourishing commercial and manufacturing city. Pop. (1910) 45,198, (1940) 82,234. It has cotton factories, smelting works, railway shops, potteries, tanneries, distilleries and wagon and tobacco factories. It is a station on the Mexican National railway, 364 mi. N.W. of the city of Mexico, and is connected by rail with Tampico on the Gulf of Mexico. The city is well built, has many fine churches and good public buildings, street cars and electric lights. Other towns of the State are Rincón de Romos (4,460), Asientos de Ibarra (1,847) and Calvillo (3,486).



CATHEDRAL AT AGUASCALIENTES
Aguascalientes, capital of the inland Mexican state of the same name, is an industrial centre for the agricultural plateau surrounding it

**AGUE,** the common name given to a form or stage of malarial disease; the ague fit is the cold, shivering stage, and hence the word is also loosely used for any such paroxysm. (*See* MALARIA.) For "brow-ague" *see* NEURALGIA.

**AGUESSEAU, HENRI FRANÇOIS D'** (1668–1751), chancellor of France, was born at Limoges Nov. 27, 1668, the son of Henri d'Aguesseau, who held many important posts in the government. He studied law under Jean Domat and was one of the first masters of forensic eloquence in France. He was procurator general from 1700 to 1717, and defended the rights of the Gallican church against Rome in the controversy which led to the promulgation of the bull *Unigenitus.*

In 1717 he was made chancellor by the regent Orleans, but was dismissed next year because of his steady opposition to the financial projects of John Law which had been adopted by the regent. He was recalled in 1720. He then assented to the truce which Dubois made with Rome because he feared the outbreak of civil war. Popular opinion unjustly ascribed his attitude to base compliance with Dubois; but he opposed other measures of Dubois and was dismissed when the favourite became chief minister. After five years of retirement spent in study, he was recalled by Cardinal Fleury, and again became chancellor. He attempted, in vain, the codification of French law, but he executed a body of reform which placed him in the same rank with L'Hôpital and Lamoignon.

His grandson, HENRI CARDIN JEAN BAPTISTE, MARQUIS D' AGUESSEAU (1746–1826), was advocate general in the parlement of Paris and deputy in the estates-general. Under the consulate he became president of the court of appeal and later minister at Copenhagen. He was elected to the French academy in 1787.

Of H F. d'Aguesseau's works the most complete edition is that of Jean Marie Pardessus, published in 16 vol. (1818–20); his letters were edited separately by Rives (1823); a selection of his works, *Oeuvres choisies,* was issued, with a biographical notice, by E. Falconnet in 2 vol. (Paris, 1865). His works include a treatise on money; a life of his father, which is interesting from the account which it gives of his own education; and *Metaphysical Meditations.*

*See* Charles Butler, *Mem. of Life of H. F. d'* [illegible] etc (1830); Boullée, *Histoire de la vie et des ouvrages du* [illegible] *d'Aguesseau* (Paris, 1835); Fr. Monnier, *Le Chancelier d'Aguesseau* (Paris, 1860; 2nd ed., 1863).

**AGUILAR, GRACE** (1816–47), English writer, the daughter of a Jewish merchant in London, was born in June 1816 Her works consist chiefly of religious fiction, such as *The Vale of Cedars* (1850) and *Home Influence* (1847). She also wrote, in defence of her faith and its professors, *The Spirit of Judaism* (1842) and other works. She died at Frankfurt-on-Main on Sept. 16, 1847.

**AGUILAR,** or AGUILAR DE LA FRONTERA, a town of southern Spain, in the province of Córdova. Pop. of town (1940) 15,144; mun., 16,091. Aguilar "of the Frontier" was so named in the middle ages from its position on the border of the Moorish territories. Situated in the south of the fertile *Campiña de Córdoba,* its olives and white wine are celebrated; the wine is known as Amontillado, from the adjacent town of Montilla.

**ÁGUILAS,** seaport and railway terminus, southeast Spain, province of Murcia. Pop., town (1940) 11,636; mun., 15,166. Águilas is built on the landward side of a small peninsula, between two bays and has a good harbour. It is the chief outlet for the Spanish trade in esparto grass, and exports also iron ore and other mineral products of the neighbourhood.

**AGUINALDO, EMILIO** (*c.* 1869– ), Filipino insurrectionary leader, was born near Cavite, Luzon, of Chinese and Tagalog parentage. He was educated in his native town and in the University of St. Thomas, Manila. At the outbreak of the insurrection in Aug. 1896, he was mayor of Cavite Viejo. During this uprising Aguinaldo took a prominent part. But in Jan. 1898 he left the Philippines for Hong Kong, agreeing to remain permanently in exile on condition of a substantial financial reward from Spain coupled with the promise of liberal reforms. Immediately after the battle of Manila, May 1, 1898, he returned to the Philippines with the express purpose, it is said, of assisting the U.S. in the war with Spain. Obtaining the consent of the U.S. authorities, he established a native government and proclaimed a Philippine republic, of which he became the head, and reorganized the army. Because the U.S. did not recognize Philippine independence, he began hostilities against the United States on Feb. 4, 1899, by making an unsuccessful attack on Manila. During 1899 there were several severe engagements, but in the end the native troops became so hard pressed that Aguinaldo was forced to take refuge in the mountains. On March 23, 1901, he was captured by Gen. Frederick Funston at Palawan, Luzon. On April 19, 1901, Aguinaldo took the oath of allegiance to the United States and retired to private life. In 1950, Pres. Elpidio Quirino appointed him a member of the council of state.

**AGUIRRE, LOPE DE** (1508–1561), Spanish adventurer. In 1559 he joined Pedro de Ursua's expedition to the Upper Amazon, in search of El Dorado, and took part in the murder of Ursua and his lieutenant in 1561, after which Guzman was elected captain by the crew, with Aguirre as his master of the camp. The murderers declared themselves rebels, and sailed down the Amazon, plundering and putting to the sword whole villages of Indians. Aguirre established a reign of terror on board ship, which culminated in the murder of Guzman, and his own self-appointment to the position of captain. In July of 1561 the party reached Margarita Island, where they murdered the governor, robbed the royal treasury and proceeded to make incursions into the mainland of Venezuela. About this time Aguirre wrote and despatched an amazing letter to the king of Spain, accusing him of ingratitude toward himself, Aguirre, and his followers, and giving a full account of his own villainous exploits on the voyage.

Soon after, his men began to desert him and just when an attack was expected from Spanish troops, he was shot by his own fellow-rebels, in Oct. 1561.

*See* R. Southey, *[illegible] of the Crimes of Aguirre* (1821); and P. Sim[illegible] *dro de Ursua and Lope de Aguirre in search o[illegible]* (1861).

**AGUJARI, LUCREZIA** (1743–1783), an Italian operatic singer, possessed of one of the most extraordinary voices, in respect of its almost incredible compass, ever known. Mozart, who heard her at Parma in 1770, noted down some of the passages which she sang, showing her range to have extended from middle C to C in altissimo, or more than an octave above the B flat which is about the limit of the average soprano At the same time she was a brilliant executant Known (and advertised) as *La Bastardella,* on account of the circumstances of her birth, as the natural daughter of a man of rank, she paid many visits to London where she received as much as £100 a night.

**AHA,** of Shabha, an 8th-century Talmudist He was author of *Quaestiones* (*Sheiltoth*), a collection of homilies (at once learned and popular) on Jewish law and ethics This is recorded as the first work written by a Jewish scholar after the completion of the Talmud.

**AHAB,** son of Omri, king of Israel from *c* 875 to *c.* 852 B.C. (I Kings xvi 29–xxii. 40). The more important aspects of his reign, which in some respects marks the high water mark of the success of the northern kingdom, may be summarized as follows (1) *Foreign relations.*—In the reigns of Omri and Ahab the northern kingdom for the first time took an important part in international politics Omri left to his son an empire which comprised not only territory to the east of Jordan, in Gilead and probably Bashan, but also the land of Moab, whose king was tributary, while Judah (and probably Edom also) if not actually subject to Omri, was certainly a subordinate ally Ahab's marriage with Jezebel, daughter of Ethbaal of Sidon, revived an alliance which had been in abeyance since the time of Solomon But throughout the reign of Ahab a fierce border war was waged with Damascus, in which Israel, in spite of occasional victory, proved the weaker, while Mesha, king of Moab, successfully revolted and occupied the southern portions of the territory of Gad. Yet the forces of Israel retained strength enough to contribute the second largest contingent of soldiers (the largest force of chariots) to the combined armies which, under the leadership of Benhadad of Damascus, checked the westward movement of Shalmaneser III. of Assyria at Karkar in 853 B.C. After the Assyrian repulse, however, the alliance broke up, and Ahab met his death fighting the Syrians in a vain attempt to recover Ramoth Gilead. (2) *Domestic affairs.*—Contact with a wider world, and especially the alliance with Phoenicia, had far-reaching results for the kingdom of Israel itself. Jezebel attempted to introduce into religion and government elements which were common enough elsewhere in the ancient world but strange in Israel. She endeavoured to set up the worship of the Tyrian Baal in Samaria, and to maintain the familiar oriental principle of the absolute despotic power and authority of the sovereign. This roused the bitter hostility of that conservative party which clung to the sole worship of the national God, Yahweh, and at the same time held to those democratic conceptions of society which the Hebrews had brought with them from the wilderness and had consistently maintained through their history. The spirit of this party found expression in the prophet Elijah (*q.v.*), who protested alike against the establishment of the Baal priests and the judicial murder of Naboth. He and those who came after him seem to have been successful in eliminating the foreign worship, though in the end their purpose was only achieved by a bloody revolution; but they were powerless to stem the tide of social and moral deterioration. (*See* Amos.) It is to the reign of Ahab that we may trace the beginning of that sapping of the national life which led to the condemnations of the 8th century prophets and to the downfall of Samaria.

(T. H. R.)

**AHAGGAR,** general name for a large plateau region of the north centre of the Sahara, culminating about 9oom. due S. of Algiers and 1,2oom. due N. of the mouth of the Niger. The highest peaks do not greatly exceed 8,oooft. above sea-level. (*See* also Sahara)

**AHASUERUS,** a royal Persian name occurring in Ezra iv. 6, Dan. ix. 1, and throughout the book of Esther, but its occurrence in Tobit xiv. 15, in some Greek mss., is due to a copyist's blunder. It is the Latinized form of the Hebrew *Aḥašwērōš* (LXX. 'Ασσούηρος). In Ezra iv. 6 Ahasuerus is mentioned as a king of Persia, to whom the enemies of the Jews sent representations opposing the rebuilding of the temple at Jerusalem. He here occupies a place in a chronological series of those Persian rulers who were directly concerned with events of Jewish history. (*See* Ezra and Nehemiah, Books of) Immediately preceding Artaxerxes I. Longimanus, he is evidently to be identified with Xerxes. This conclusion is supported by the resemblance of the Hebrew form of the name to the Babylonian *Aḫšyarš(u)*, the Egyptian-Aramaic transliterations, etc. The old Persian form, found in inscriptions, is *Khšayāršā.*

In the book of Esther the king, at whose court the scene is laid, bears the same Hebrew name, rendered *Assuerus* in the Latin version and Ahasuerus in the English Bible (but in LXX. "Artaxerxes" throughout) Most modern scholars are agreed that here also Xerxes is the king intended (*See* Esther)

In Dan ix. 1 "Ahasuerus" (*Aḥašwērōš*) is the father of "Darius the Mede," who is said to have become king over Babylonia upon the death of Belshazzar. (*See* also v 30, vi. 1, 29.) The name seems impossible here, however, and is probably due to some accident in the literary transmission (Josephus, *Ant.* x. 11, 4, has "Astyages"). It was perhaps originally a Hebrew form of *Huwaḫšatara* (Cyaxares) No other name resembling Ahasuerus, nor any name like Darius, is to be found in the list of Median kings. We know, moreover, from the Cyrus cylinder, as well as from the Greek historians, that the immediate successor of Nabonidus and Belshazzar as ruler of Babylonia was Cyrus (he is represented in Dan. x. 1, xi. 1, as successor of this Darius). Comparison with the list of Persian kings in the book of Ezra (see above) seems to show that in the Jewish tradition Darius I. Hystaspis was placed before Cyrus as "Darius the Mede."

*See* articles "Ahasuerus" in the *Encyclopaedia Biblica,* Hastings' *Dictionary,* the *Jewish Encyclopaedia;* Driver, *Introd. to the Lit. of the Old Test.;* Torrey, *Ezra Studies,* pp. 38 *seq.,* 135 *seq.,* 141.

(C. C. T)

**AHAZ,** king of Judah. After the death of Menahem, Pekah, king of Israel, and Rezin (rather Rasun), king of Syria, allied against Assyria and invaded Judah. At the same time the Edomites recovered Elath on the Gulf of Akabah and Judah was isolated. Notwithstanding the counsel of Isaiah, Ahaz called in the aid of Tiglath-pileser I, who, after attacking the Philistines, destroyed the power of Syria, and exacted heavy tribute from Judah It was as a vassal that Ahaz presented himself to the Assyrian king at Damascus, and brought back religious innovations, on the nature of which *see* W. R. Smith, *Relig. of Semites,* pp. 485 sqq. and commentaries on II. Kings xvi. 17.

**AHAZIAH,** the name of two kings in the Bible. (1) Ahaziah, 8th king of Israel, was the son and successor of Ahab, and reigned for less than two years. On his accession the Moabites refused any longer to pay tribute. Ahaziah lost his life through a fall from the lattice of an upper room in his palace (2 Kings i. 2–17). (2) Ahaziah, 6th king of Judah, son of Jehoram and Ahab's daughter Athaliah, reigned one year. He, together with Joram, king of Israel, was slain by Jehu, son of Nimshi. He is variously called Jehoahaz and Azariah (2 Kings viii. 25–ix.28).

**AHENOBARBUS** [Lat. "brazen-bearded"], the name of a very extensive plebeian Roman family of the *gens Domitia.* The name was derived from the red beard and hair by which many of the family were distinguished. Amongst its members the following may be mentioned:—

Gnaeus Domitius Ahenobarbus, tribune of the people 104 B.C., brought forward a law (*lex Domitia de Sacerdotiis*) by which the priests of the superior colleges were to be elected by the people in the *comitia tributa* instead of by co-optation; the law was repealed by Sulla, revived by Julius Caesar and (perhaps) again repealed by Marcus Antonius, the triumvir (Cicero *De*

*Lege Agraria*, ii. 7; Suetonius, *Nero*, 2). Ahenobarbus was elected pontifex maximus in 103, consul in 96 and censor in 92 with Lucius Licinius Crassus the orator, with whom he was frequently at variance. They took joint action, however, in suppressing the recently established Latin rhetorical schools, which they regarded as injurious to public morals (Aulus Gellius xv. 11).

LUCIUS DOMITIUS AHENOBARBUS, son of the above, and husband of Porcia the sister of Cato Uticensis. Being a convinced aristocrat he opposed Pompey and Caesar while they were united, and when their friendship cooled, attached himself to Pompey. He was consul in 54 B.C., and in 49 B.C. he was appointed by the senate to succeed Caesar as governor of Gaul. After the outbreak of the civil war he commanded the Pompeian troops at Corfinium, but was obliged to surrender. Although treated with great generosity by Caesar, he stirred up Massilia (Marseille) to an unsuccessful resistance against him. After its surrender, he joined Pompey in Greece and was slain in the flight after the battle of Pharsalus (Caesar, *Bellum Civile*, i., ii., iii., Dio Cassius xxxix., xli.; Appian, B.C. ii. 82).

GNAEUS DOMITIUS AHENOBARBUS, son of the above, accompanied by his father at Corfinium and Pharsalus, and, having been pardoned by Caesar, returned to Rome in 46 B.C. After Caesar's assassination he attached himself to Brutus and Cassius, and in 43 B.C. was condemned by the *lex Pedia* as having been implicated in the plot. He obtained considerable naval successes in the Ionian sea against the triumvirate, both before and after Philippi, but in 40 B.C. became reconciled to Antony, who made him governor of Bithynia. He took part in Antony's Parthian campaigns, and was consul in 32 B.C. When war broke out between Antony and Octavian, he at first supported Antony, but, disgusted with his intrigue with Cleopatra, went over to Octavian shortly before the battle of Actium (31 B.C.). He died soon afterwards (Dio Cassius xlviii.–l.; Appian, *Bell. Civ.*, iv., v.). His son was married to Antonia, daughter of Antony, and became the grandfather of the emperor Nero.

*See* Drumann, *Geschichte Rom.*, 2nd ed. by Groebe, vol. iii. pp. 14 ff.

**AHITHOPHEL,** one of David's most trusted advisers, whose counsel was "as though one inquired of the word of God." He took a leading part in Absalom's revolt, and his defection was a severe blow to the king, who prayed that God would bring his counsel to "foolishness." At Ahithophel's advice Absalom first took the precaution of asserting his claim to the throne by seizing his father's concubines. The immediate pursuit of David was then suggested but Hushai recommended waiting till the levies of all Israel could be called up. This advice was adopted, and David had time to escape across the Jordan. Finding that his policy was neglected, and foreseeing the disaster which actually occurred, Ahithophel went home and hanged himself. (2 Sam. xv. 31–37; xvi. 20–xvii. 14, 23.)

**AHLEN,** a town in the southeast of the district of Münster, in the Prussian province of Westphalia. Pop. (1939) 25,461. It produces metalwork, enamelling, die stamping, galvanizing, etc.

**AḤMAD IBN ḤANBAL** (780–855), the founder, involuntarily and after his death, of the Ḥanbalite school of canon law, was born at Baghdad in A.H. 164 (A.D. 780) of parents from Merv, but of Arab stock. He studied the Koran and its traditions (*ḥadîth, sunna*) there and on a student journey through Mesopotamia, Arabia and Syria. After his return to Baghdad he studied under ash-Shāfi'i between A.H. 195 and 198, and became, for his life, a devoted Shāfi'ite. But his position in both theology and law was more narrowly traditional than that of ash-Shāfi'i; he rejected all reasoning, whether orthodox or heretical in its conclusions, and stood for acceptance on tradition (*naql*) only from the Fathers. In consequence, when al-Ma'mūn and, after him, al-Mu'tasim and al-Wāthiq tried to force upon the people the rationalistic Mu'tazilite doctrine that the Koran was created, ibn Ḥanbal, the most prominent and popular theologian who stood for the old view, was imprisoned and scourged. In A.H. 234, under al-Motawakkil, the Koran was finally decreed uncreated, and ibn Ḥanbal who had come through this trial better than any of the other theologians, enjoyed an immense popularity with the mass of the people as a saint, confessor and ascetic. He died at Baghdad in A.H. 241 (A.D. 855) and was buried there.

BIBLIOGRAPHY.—On his great work, the *Musnad*, a collection of some 30,000 selected traditions, *see* Goldziher in *ZDMG*, l. 465 ff. For his life and works generally, *see* W. M. Patten, *Ahmed ibn Ḥanbal and the Miḥna*; C. Brockelmann, *Geschichte der Arab. Lit.* i. 181 ff.; F. Wustenfeld, [illegible], 55 [illegible]; M'G. de Slane's transl. of *Ibn Khallikan*, i. 44 ff.; Macdonald, *Development of Muslim Theology*, 110, 157, index.

**AḤMADIYYAH:** *see* ISLAM.

**AḤMAD SHAH** (1724–73), founder of the Durani dynasty in Afghanistan, was the son of Sammaun-Khan, hereditary chief of the Abdali tribe. While still a boy, Ahmad fell into the hands of the hostile tribe of Ghilzais, by whom he was kept prisoner at Kandahar. In March 1738 he was rescued by Nadir Shah, who soon afterwards gave him the command of a body of cavalry composed chiefly of Abdalis. On the assassination of Nadir in 1747, Ahmad, having failed in an attempt to seize the Persian treasures, retreated to Afghanistan, where he persuaded the tribes to assert their independence and accept him as their sovereign. He was crowned at Kandahar in Oct. 1747, and about the same time he changed the name of his tribe to Durani. He first crossed the Indus in 1748, when he took Lahore; and in 1751, after a feeble resistance on the part of the Mohammedan viceroy, he became master of the entire Punjab. In 1750 he took Nishapur and in 1752 subdued Kashmir. His great expedition to Delhi was undertaken in 1756 in order to avenge himself on the Great Mogul for the recapture of Lahore. Ahmad entered Delhi with his army in triumph, and for more than a month the city was given over to pillage. The shah himself added to his wives a princess of the imperial family, and bestowed another upon his son Timur Shah, whom he made governor of the Punjab and Sirhind. As his viceroy in Delhi he left a Rohilla chief in whom he had all confidence, but scarcely had he crossed the Indus when the Mohammedan wazir drove the Afghan chief from the city, killed the Great Mogul and set another prince of the family, a tool of his own, upon the throne. The Mahratta chiefs availed themselves of these circumstances to endeavour to possess themselves of the whole country, and Ahmad was compelled more than once to cross the Indus in order to protect his territory from them and the Sikhs, who were constantly attacking his garrisons. In 1758 the Mahrattas obtained possession of the Punjab, but on Jan. 6, 1761, they were totally routed by Ahmad in the great battle of Panipat. In a later expedition he inflicted a severe defeat upon the Sikhs, but had to hasten westwards immediately afterwards in order to quell an insurrection in Afghanistan. Meanwhile the Sikhs again rose, and Ahmad was forced to abandon all hope of retaining the command of the Punjab. He died in 1773, leaving to his son Timur the kingdom he had founded.

**AHMED I.** (1589–1617), sultan of Turkey, was the son of Mohammed III., whom he succeeded in 1603, being the first Ottoman sultan who reached the throne before attaining his majority. He was of kindly and humane disposition, as he showed by refusing to put to death his brother Mustafa, who eventually succeeded him. In the earlier part of his reign he gave proof of decision and vigour, which were belied by his subsequent conduct. The wars which attended his accession both in Hungary and in Persia terminated unfavourably for Turkey, and her prestige received its first check in the peace of Sitvatörök, signed in 1606, whereby the annual tribute paid by Austria was abolished. Ahmed gave himself up to pleasure during the remainder of his reign—which ended in 1617—and demoralization and corruption had become as general throughout the public service as indiscipline in the ranks of the army. The use of tobacco is said to have been introduced into Turkey during Ahmed I.'s reign.

**AHMED II.** (1643–95), sultan of Turkey, son of Sultan Ibrahim, succeeded his brother Suleiman II. in 1691. His chief merit was to confirm Mustafa Kuprili as grand vizier. But a few weeks after his accession Turkey sustained a crushing defeat at Slankamen (1691) from the Austrians under Prince Louis of Baden and was driven from Hungary; during the four years of his reign disaster followed on disaster, and on Feb. 6, 1695, Ahmed died, worn out by disease and sorrow.

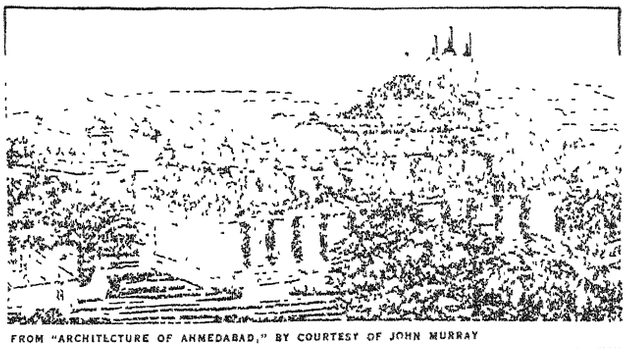
**AHMED III.** (1673–1736), sultan of Turkey, son of Moham-

med IV., succeeded to the throne in 1703 on the abdication of his brother Mustafa II. He cultivated good relations with England, and he afforded a refuge in Turkey to Charles XII. of Sweden, after his defeat at Poltava (1709). Forced into war with Russia, he came nearer than any Turkish sovereign before or since to breaking the power of his northern rival, whom his grand vizier, Baltaji Mohammed Pasha succeeded in completely surrounding near the Pruth (1711) In the treaty which Russia was compelled to sign, Turkey obtained the restitution of Azov, the destruction of the forts built by Russia, and the understanding that the tsar should abstain from future interference in the affairs of the Poles or the Cossacks. Discontent at the leniency of these terms was so strong at Constantinople that it nearly brought on a renewal of the war. In 1715 the Morea was taken from the Venetians This led to hostilities with Austria, in which Turkey was unsuccessful, and Belgrade fell into the hands of Austria (1717). Through the mediation of England and Holland the peace of Passarowitz was concluded (1718), by which Turkey retained her conquests from the Venetians, but lost Hungary. A war with Persia terminated in disaster, leading to a revolt of the janissaries, who deposed Ahmed in Sept. 1730.

**AHMEDABAD**, a city and district of British India in the Northern division of Bombay. Pop. (1941) 591,267. The city was once the handsomest and most flourishing in western India, and it still ranks next to Agra and Delhi for the beauty and extent of its architectural remains. It was founded by Ahmad Shah in A.D. 1411 on a site used for earlier Hindu towns, and embellished with fine buildings of marble brought from a distance. The Portuguese Barbosa described it as "very rich and well embellished, with good streets and squares supplied with houses of stone and cement." In Sir Thomas Roe's time, A.D. 1615, "it was a goodly city as large as London." From 1411 to 1511 it grew in size and wealth; from 1512 to 1572 it declined with the decay of the dynasty of Gujarat; from 1572 to 1709 it renewed its greatness under the Moghul emperors; from 1709 to 1809 it dwindled with their decline; and from 1818 onwards it again increased under British rule.

In consequence of these changes of dynasty, Ahmedabad became the meeting place of Hindu, Mohammedan and Jain architecture. Ahmad Shah pulled down Hindu temples in order to build his mosques with the material. The Jama Masjid itself, with its 300 pillars fantastically carved, is a Hindu temple converted into a mosque.

Many of the houses are most beautifully carved and there are numerous fine mosques, tombs, etc. One of the finest is the modern Jain temple of Hathi Singh outside the Delhi gate, which was built only in 1848. Two of the windows in Sidi Said's mosque



FROM "ARCHITECTURE OF AHMEDABAD," BY COURTESY OF JOHN MURRAY

THE TEMPLE OF HATHI SINGH AT AHMEDABAD, BUILT IN 1848 AS THE LOCAL SHRINE OF JAINISM

of filigree marble work are marvels of delicacy and grace, and finer than anything of the kind to be found in Agra or Delhi.

The modern city of Ahmedabad is situated on the left bank of the river Sabarmati; Sabarmati, on the opposite bank of the river, is practically part of Ahmedabad. It has a station on the Bombay and Baroda railway, 309 mi. from Bombay, whence branch lines diverge to Delhi, Khed Brahma and Dolka, and is the largest centre for trade and manufacture in the province after Bombay. Its native bankers, shopkeepers and workers are all strongly organized in guilds It has numerous cotton mills, about one-third of the population being dependent on the cotton industry, and factories for ginning and pressing cotton. Other industries include oil, flour and silk mills, manufactures of soap, matches, glass, tobacco and hosiery, carpet works and tanneries Ahmedabad is famous for its handicrafts, including brocades and tinsel lace, copper and brass working, jewellery and wood carving Filtered water is obtained from wells in the river bed and the main streets are lighted by electricity. The military cantonment, 3 mi. N. of the native town, is the headquarters of the northern division of the Bombay command, with an arsenal.

The district of Ahmedabad lies at the head of the gulf of Cambay, between Baroda and Kathiawar. Area 3,879 sq mi Pop (1941) 1,372,171. The river Sabarmati and its tributaries, flowing from northeast to southwest into the gulf of Cambay, are the principal streams that water the district. The northeastern portion is dotted with low hills, which gradually sink into a vast plain, subject to inundation on its western extremity With the exception of this latter portion, the soil is very fertile, and some parts are wooded The principal crops are millets, cotton, wheat and pulse The district is traversed by the Bombay and Baroda railway, and has two seaports, Dholera and Gogo, the former of which has given its name to a mark of raw cotton in the Liverpool market.

**AHMEDNAGAR**, a city and district of British India in the Central division of Bombay on the left bank of the river Sina. Pop. (1941) 54,193. The town was founded in 1494 on the site of a more ancient city, Bhingar, by Ahmad Nizam Shah, who established a new monarchy, which lasted till its overthrow by Shah Jahan in 1636. In 1759 the Peshwa obtained possession of the place by bribery, and in 1797 it was ceded to the Mahratta chief, Daulat Rao Sindhia. During the war with the Mahrattas in 1803, Ahmednagar was invested by Gen. Wellesley and captured. Restored to the Mahrattas, it again became a British possession in 1817, under the treaty of Poona. There is a large trade in cotton and silk goods, while turbans and copper and brass pots are made. There are also factories for ginning and pressing cotton, indigo works and a tannery. Ahmednagar is a station on the loop line of the Great Indian Peninsula railway, 218 mi. from Bombay, a military station of the Poona district and an important mission station.

The district of Ahmednagar is a comparatively barren tract with a small rainfall. The area is 6,646 sq.mi. The population in 1941 was 1,142,229, showing a slight increase in the decade. On the north the district is watered by the Godavari and its tributaries, the Prawara and the Mula; on the northeast by the Dor, another tributary of the Godavari; on the east by the Sephani, which flows through the valley below the Balaghat range; and in the extreme south by the Bhima and its tributary the Gor. The Sina river, another tributary of the Bhima, flows through the Nagar and Karjat talukas.

The principal crops are cotton, millet, pulse and wheat and dyes are produced

**AHMED VEFIK, PASHA** (1819–1891), Turkish statesman and man of letters, was born in Stambul and educated in Paris. He was appointed to a post in the *bureau de traduction* of the ministry for foreign affairs, and devoted his leisure to the translation of Molière's plays into Turkish and to the compilation of educational books (dictionaries, historical and geographical manuals, etc.) for use in Turkish schools. In 1847 he brought out the first edition of the *Salnameh*, the official annual of the Ottoman empire. Two years later he was appointed imperial commissioner in the Danubian principalities, and in 1851 ambassador to Persia. After his return he was appointed a member of the Grand Council of Justice, and was entrusted with the revision of the penal code and the code of procedure.

In 1860 he was sent as ambassador to Paris, to avert the intervention of France in the affairs of Syria. Ahmed Vefik held various important posts in the Turkish government during the next two decades, and was twice minister of public instruction, but the position in which he rendered his most distinguished

**Aids and the Great Charter.**—The Great Charter, as before stated, extended specially to London the limitation on baronial "aids," but left untouched its liability to tallage, a lower and more arbitrary form of taxation, which the towns shared with the crown's demesne manors, and which London resisted in vain. The two exactions, although distinct, have to be studied together, and when in 1296–97 Edward I was forced to his great surrender, he was formerly supposed by historians to have pledged himself, under *De tallagio non concedendo,* to levy no tallage or aid except by common consent of his people. It is now held, however, that he limited this concession to *aides, mises* and *prises,* retaining the right to tallage. Eventually, by a statute of 1340, it was provided that the nation should not be called upon "to make any common aid or sustain charge" except by consent of parliament. The aids spoken of at this period are of yet another character, namely, the grant of a certain proportion of all "movables" (*i.e.,* personal property), a form of taxation introduced about 1188 and of rapidly increasing importance These subsidies were conveniently classed under the vague term "aids," as were also the grants made by the clergy in convocation, the term covering both feudal and non-feudal levies from the higher clergy and proportions not only of "movables" but of ecclesiastical revenues as well.

The "knight's aid" of 1130 spoken of above is probably identical with *auxilium exercitus* mentioned in the oldest custumals of Normandy, where the phrase appears to represent what was known in England as "scutage" Even in England the phrase *"quando Rex accipit auxilium de militibus"* occurs in 1166 and appears to be loosely used for scutage.

The same loose use enabled the early barons to demand "aid" from their tenants on various grounds, such as their indebtedness to the Jews, as is well seen in the Norfolk fragments of returns to the Inquest of Sheriffs (1170).

Sheriff's aid was a local payment of a fixed nature paid in early days to the sheriff for his service. It was the subject of a hot dispute between Henry II and Becket in 1163.

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**AIGRETTE,** the long back plumes which the egret (*q.v.*) assumes in the breeding season, the use of which as ornaments in women's headdresses has become rare, owing to the protests of humanitarians because of the cruelty involved in slaughtering the birds and leaving their young to starve. The name is also given to any similar ornament, in gems, etc., to the insignia of rank of colonels in the French army and, in science, to feathery excrescences such as the *pappus* of the dandelion and the luminous rays seen diverging from the moon's edges in solar eclipses.



BY COURTESY OF THE CHAMBER OF COMMERCE OF THOMASVILLE, GA.

EGRETS ON A SOUTHERN RESERVE ESTABLISHED AND MAINTAINED BY THE NATIONAL ASSOCIATION OF AUDUBON SOCIETIES

**AIGUESMORTES,** a town of southeast France, department of Gard, 25 mi SSW. of Nîmes on a branch line of the P.L.M. railway. Population (1936) 3,458. It occupies an isolated position in the marshy plain at the western extremity of the Rhône delta, 2½ mi. from the Gulf of Lions. Louis IX embarked from Aiguesmortes in 1248 and 1270 for the 7th and 8th crusades, and developed the town. The mediaeval fortifications which surround it are of great interest. They form a parallelogram 596 yd. long by 149 yd. broad and consist of crenellated walls from 25 to 36 ft. in height, dominated by towers, of which the Tour de Constance (N.W.), built by Louis IX, was used as a prison for Protestants after the revocation of the Edict of Nantes. The fortifications were completed under Philip III. To further the prosperity of the town a most liberal charter was granted to it, and in addition the trade of the port was artificially fostered by a decree requiring that every vessel navigating within sight of the lights should put in there. This ordinance remained in force till the reign of Louis XIV. The town, although steadily decreasing in population, remains important historically as an outstanding example of mediaeval city planning. Aiguesmortes is the meeting-place of several canals connecting with Beaucaire, Cette, the Petit Rhône and the Mediterranean. Fishing and the manufacture of soda are industries, with trade in coal, fruits and wine In the surrounding country there are important vineyards, which are preserved from disease by periodical submersion.

**AIGUILLE** (Fr. for needle), the sharp jagged point above the snow-line formed by a part of a mountain which has been split by frost action along joints or planes of cleavage with sides too steep for snow to rest upon them. Aiguilles are thus the forms left from the splitting up of the high ridges with "house-roof" structure into detached pinnacles. (*See* ARÊTE)

**AIGUILLON, EMMANUEL ARMAND DE WIGNEROD DU PLESSIS DE RICHELIEU,** DUC D' (1720–1782), French statesman, nephew of the maréchal de Richelieu, was born on July 31, 1720. He was a member of the so-called *parti dévot,* the faction opposed to Madame de Pompadour, to the Jansenists, and to the parlement. In 1753 he was appointed commandant (governor) of Brittany and was engaged in constant disputes with the Breton parlement, in 1768 returning to court, where he resumed his intrigue with the *parti dévot* and finally obtained the dismissal of the minister Choiseul (Dec. 24, 1770) When Louis XV, acting on the advice of Madame du Barry, reorganized the government with a view to suppressing the resistance of the parlements, d'Aiguillon was made minister of foreign affairs, Maupeou and the Abbé Terray (1715–1778) also obtaining places in the ministry. D'Aiguillon was blamed for having provoked the *coup d'état* of Gustavus III, king of Sweden, in 1772, although the instructions of the comte de Vergennes, the French ambassador in Sweden, had been written by the minister, the duc de la Vrillière. D'Aiguillon, however, could do nothing to rehabilitate French diplomacy; he acquiesced in the first division of Poland, renewed the Family compact, and, although a supporter of the Jesuits, sanctioned the suppression of the society. After the death of Louis XV he quarrelled with Maupeou and with the young queen, Marie Antoinette, who demanded his dismissal from the ministry (1774). He died, forgotten, in 1782.

See *Mémoires du Ministère du duc d'Aiguillon* (3rd ed., 1792), probably written by J. L. Soulavie. On d'Aiguillon's governorship of Brittany *see* Carré, *La Chalotais et le duc d'Aiguillon* (1893); Marion, *La Bretagne et le duc d'Aiguillon* (1898); and Barthélemy Pocquet, *Le Duc d'Aiguillon et La Chalotais* (1901–02). The three last have full bibliographies. *See* also Flammermont *Le Chancelier Maupeou et les parlements* (1883); [illegible] *Le Cardinal de Bernis* (1884).

**AIGUILLON, MARIE MADELEINE DE WIGNEROD DU PONT DE COURLAY,** DUCHESSE D' (1604–75), daughter of Cardinal Richelieu's sister. In 1620 she married a nephew of the Constable de Luynes, Antoine de Beauvoir du Roure, Sieur de Combalet, who died in 1622. In 1625, through her uncle's influence, she was made a lady-in-waiting (*dame d'atour*) to the queen-mother, and in 1638 was created duchess of Aiguillon. After the death of the cardinal (1642) she withdrew from the court, and devoted herself entirely to works of charity. She helped St. Vincent de Paul to establish the hospital for foundlings, and also took part in organizing the General hospital and several others in the provinces. She died on April 17, 1675. Corneille dedicated to her his tragedy of *Le Cid.*

*See* E. Fléchier, *Oraison funèbre de Mme. Marie de Wignerod, duchesse d'Aiguillon,* Bonneau-Avenant, *La duchesse d'Aiguillon* (1879); *Mémoires de Saint-Simon,* ed. by A. de Boislisle (1879 *et seq.*).

**AIGUN,** 49° 58′ N. 127° 35′ E., a treaty port on the south bank of the Amur in northern Manchuria on the extreme north-

eastern frontier of China. Population 38,112. It lies on the opposite bank to, but about 20 mi below, the Russian city of Blagoveshchensk The treaty of Aigun (1858) was one of a series of treaties which attempted to define the boundaries between the Chinese and Russian empires. With political and strategic developments along the Siberia-Manchuria frontier and with the diversion of river trade to the north Manchurian (former Chinese Eastern) railway, it has lost its former importance as an entrepôt for the shipment of cattle, meat and grains across the Amur to Blagoveshchensk.

**AIKEN,** a city of South Carolina, U.S., 17 mi. E.N.E. of Augusta, Ga., 565 ft. above sea level; the county seat of Aiken county. It is on federal highways 1 and 78 and is served by the Southern railway. Population (1950) 7,067; (1940) 6,168. The climate is unusually dry and equable. Fox hunting, pigeon shooting, polo, polo tennis, steeplechase and flat racing and golf are popular sports. With its seven polo fields, Aiken is a winter training ground for this game. Aiken was settled early in the 19th century and was incorporated in 1835. It was on the line of one of the earliest railways, and was named after the first president of that road, William Aiken (1806–87), who was governor of the State (1844–47).

**AIKIN, JOHN** (1747–1822), English physician and author, was born at Kibworth-Harcourt on Jan. 15, 1747, and died at Stoke Newington, London, on Dec. 7, 1822. He practised as a consulting physician in London from 1792 onwards, but gradually became absorbed in literary pursuits. Aikin and his sister, Anna Letitia Barbauld, wrote popular books which had a great vogue. Their admirable miscellany, *Evenings at Home* (1792–95) was translated into many European languages. Aikin's voluminous works include *General Biography* (1799–1815), and *Lives of John Selden and Archbishop Usher* (1812).

His daughter, LUCY AIKIN (1781–1864), born at Warrington on Nov. 6, 1781, wrote several books for children, including versions of classical stories written in metre. She also wrote: a novel, *Lorimer* (1814); *Memoirs of the Court of Queen Elizabeth* (1818); *Memoirs of the Court of James I.* (1822); *Memoirs of the Court of Charles I.* (1833) and a *Life of Addison* (1843). Miss Aikin died at Hampstead on Jan. 29, 1864.

*See* a *Memoir of John Aikin, with selections of his miscellaneous pieces* (1823), by his daughter; and the *Memoirs, Miscellanies and Letters of Lucy Aikin* (1864), including her correspondence (1826–42) with William Ellery Channing, edited by P. H. Le Breton.

**AILANTHUS** (more correctly *ailantus,* from *ailanto,* an Amboyna word probably meaning "Tree of the Gods," or "Tree of Heaven"), a genus of trees belonging to the quassia family (Simarubaceae). The best known species, tree of heaven or Chinese sumac (*Ailanthus altissima*), is a handsome, rapidly growing tree with spreading branches and large pinnately compound leaves bearing many lance-shaped leaflets with conspicuous glandular bases. The small greenish flowers are borne in branched panicles; the staminate (male), upon opening, exhale a most disagreeable odour. The fruit is a samara with a single centrally disposed seed in the elliptical, twisted, fibrous wing. This tree, which is a native of China and Japan, was introduced into England in 1751 and is a favourite in parks and gardens. It has been planted extensively in the eastern United States and is one of a few trees capable of thriving in smoky atmospheres adjoining industrial centres. Two other species, *A. imberbiflora* and *A. punctata,* are Australian trees of secondary importance; *A. excelsa* is a common tree in India. (E. S. HR.)

**AILANTHUS, CYNTHIA** or **ERIA SILK MOTH** (*Philosamia cynthia*), a member of the so-called "wild" silk moths, ranging in many races and strains from China to Timor. It is olive or brown with a translucent white crescent on each wing. The caterpillar (the eria silkworm) is green with blue knobs; and the chief commercial strain (*P. c. ricini*) feeds on the castor oil plant. One of the races feeding on Ailanthus (*P. c. advena*) was introduced from China to France and thence to the U.S., and is established in France, Germany and along the Atlantic coast. Other races feed on Ilex, Zanthoxylum and other trees. (*See* SILK AND SERICULTURE: *Wild Silks.*)

*See* H. Rebel, "Revision des Formenkreises von *Philosamia cynthia* Dru.," *Annalen des naturhistorischen Museums in Wien,* xxxix 154–176, 1925 (races); Schüssler, "Saturniidae," *Lepidopterorum Catalogus,* lv, 24–41, lxv, 517–564, 733, bibliog. (1934). (W. T. M. F.)

**AILERON,** a hinged or movable portion of an aeroplane wing, the function of which is to impress a motion on the aeroplane about its longitudinal axis. Situated generally at the rear edge of the wing and at or near the wing tip, the ailerons are connected to the control column by wires or push-pull rods in such a way that a movement of it, e.g., to the right, raises the aileron on the right wing and lowers that on the left wing, causing the aeroplane to bank for a turn to the right.

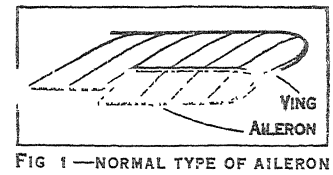



FIG. 1.—NORMAL TYPE OF AILERON
The banking of an aeroplane in turning is brought about by two ailerons, one on the rear edge of each wing. One goes up as the other goes down

Ailerons of the type shown in fig. 1 are effective in normal flight but when the aeroplane is stalled (as in the last few seconds before a normal landing) they become less effective. Great attention has therefore been devoted to aileron design in aerodynamic research laboratories throughout the world. The mounting of automatic slots of the Handley-Page type (*see* AEROPLANE) along the leading edge of the wing is one of several effective methods which have been developed to retain aileron action beyond the usual stalling point. (D. SE.)

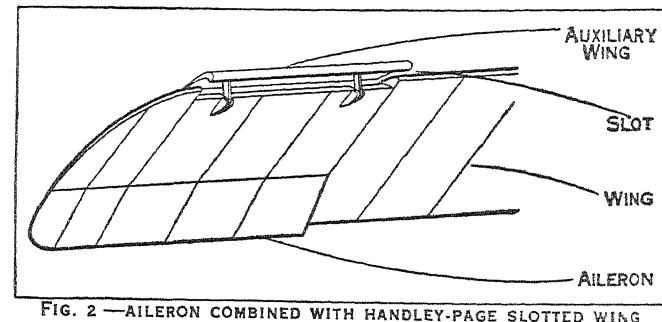



FIG. 2.—AILERON COMBINED WITH HANDLEY-PAGE SLOTTED WING
The purpose of this auxiliary wing is to remove one of the most serious risks of flying. In stalling the ailerons become ineffective. By this device the "slot" opens automatically when the wing stalls and this renders the aileron effective. The illustration shows a right wing seen from below

**AILLY, PIERRE D'** or PETRUS D'ALLIACO (1350–1420), French churchman and schoolman, was born at Compiègne and studied at the College of Navarre of the University of Paris. He became master of the college in 1384 and later obtained the highest dignity in the university, the chancellorship of Notre Dame. John Gerson was one of Ailly's pupils and his lifelong friend. The two men played an important part in the later history of the papal schism. Pierre d'Ailly acted as spokesman of the university before the king's council (May 20, 1381) with the proposal that the best way of ending the scandal of the existence of two popes, Urban VI. at Rome and Clement VII. at Avignon, was the summoning of a general council. The suggestion was unacceptable and Ailly retired from Paris for some time. As master of the College of Navarre he was twice sent by the university on missions to Clement VII., and on the death of that pope, he was sent by the king to congratulate Clement's successor, Benedict XIII. His acceptance of that mission displeased the university, which was already beginning to demand the resignation of both popes as a preliminary to the re-unification of the church. Suspicion of his attitude was deepened by his nomination by Benedict XIII. as bishop of Le Puy (1395) and then bishop of Cambrai (1397). At the ecclesiastical council, held in Paris in 1406, Ailly, by the king's order, defended Benedict XIII., and it was not until the convocation of the general Council of Pisa (1409) that he forsook Benedict's cause and returned to the point of view of the University of Paris, of which he had been the champion before his preferment. He and Gerson urged that the unity of the church could only be restored by a general council which, in case of schism, would be supreme and legitimate even though it were not convoked by the pope. The nominee of the Council of Pisa died within a year. His successor, John

XXIII, gave Ailly the bishopric of Orange and made him a cardinal. Nevertheless Ailly was one of the most formidable adversaries of John XXIII. at the Council of Constance (Nov. 1414–April 1418). He maintained that, as the decisions of the Council of Pisa had not been accepted and there were now three "popes," it was necessary to begin *de novo* and treat the claims of all three alike, and he made serious depositions against John. The theory put forward by Ailly and Gerson that the general council had jurisdiction over the pope himself was a dangerous one, and, according to later decisions, even heretical; but both men were seeking an outlet from an impossible situation Ailly found in the end an ingenious compromise on the rights of the Sacred College and the council and the schism was healed by the appointment of Martin V.

During the Council of Constance, Ailly had earned the hatred of the Anglo-Burgundians by trying to reduce the power of the English by contesting their right to form one of the four separate nations. He was compelled to retire to Avignon, where he died on Aug. 9 1420.

Pierre d'Ailly's written works are numerous. Many of them were published with the works of Gerson (by Ellies du Pin, Antwerp, 1706); others appeared in the 15th century, probably at Brussels; and there are many treatises and sermons still unpublished. In philosophy he was a nominalist.

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**AILSA CRAIG,** an island rock at the mouth of the Firth of Clyde, 10m. W. of Girvan, Ayrshire, Scotland. It is of conoidal form, with an irregular elliptic base, and rises abruptly to a height of 1,097ft. The only side from which the rock can be ascended is the east, the other sides being for the most part perpendicular, and generally presenting lofty columnar forms, though not so regular as those of Staffa. The island is composed of micro-granite with riebeckite, of great interest on account of the rare occurrence of this type in Britain. It is fine-grained and of a greyish colour, and may be of Tertiary age Pebbles of this rock were carried far south (*e.g.* to Welsh shores) by glaciers of the Ice age. The rock is a favourite material for curling-stones. Hence curling-stones are popularly known as "Ailsas" or "Ailsa Craigs." The rock is also used for paving stones. A columnar cave exists towards the north side of the island, and on the east are remains of a tower. Two springs occur and some scanty grass affords subsistence to rabbits, and, on the higher levels, to goats. The precipices have large breeding colonies of gannets and other sea birds which spend the winter months at sea. A lighthouse on the south side flashes a light visible for 13 miles. Pop. (1931) 11.

**AIMAK,** the name of nomadic or semi-nomadic Mongolian tribes inhabiting the north and north-west Afghan highlands north of Herat. *Aimak* is a Mongolian word meaning "clan" or "section of a tribe." They were originally known as "chahar (the four) eimaks," because there were four principal tribes: the Taimani, the Ferozkhoi, the Jamshidi and the Hazara. They number about 250,000, and speak a dialect akin to Kalmuck. They are Sunnite Mohammedans.

**AIMARD, GUSTAVE,** the pen-name of OLIVIER GLOUX (1818–83), French novelist, who was born in Paris Sept. 13, 1818, and died there June 20, 1883. He made use of the materials collected in a roving and adventurous youth and early manhood in numerous romances in the style of J. Fenimore Cooper. Among the best of them are: *Les Trappeurs de l'Arkansas* (1858); *La grande flibuste* (1860); *Nuits mexicaines* (1863); *La Forêt vierge* (1870)

**AIMOIN** (*c.* 960–*c.*1010), French chronicler, spent the greater part of his life in the monastery of Fleury. His chief works are. *Historia Francorum* or *Libri V de gestis Francorum*, a history of the Franks from the earliest times to 633, which was continued by other writers and brought down to the middle of the 12th century; a life of Abbo, abbot of Fleury; and books ii. and iii. of the *Miracula S. Benedicti.*

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**AIN,** a department of eastern France, formed from Bresse, the Pays de Dombes on the lowland and the Pays de Gex, Valromey and Bugey among the high parallel scarps of the Jura reaching south to the Rhône between Geneva and Lyons. Area 2,249 sq.mi. Pop. (1936) 316,710. The name is that of the river which roughly separates the two first from the other districts, running north to south at first between outer hill ranks and then along the foot of the highland to join the Rhône. The western boundary is the Saône, the southern the Rhône, the eastern Switzerland and the northern the departments of Saône-et-Loire and Jura, the boundary over against the latter being closely linked with that of old between Burgundy and Franche Comté. The Pays de Gex includes some of the highest Jura scarps (Crêt de la Neige 5 653-ft.), the Pays de Valromey flanks on the west the deep Rhône gorge below Bellegarde, the Pays de Bugey is the south-pointing triangle of the Rhône focussing on Belley. West of the hills, Bresse occupies the fertile north part of the department and is effectively drained to the Saône, thus contrasting with the Pays de Dombes, mantled in boulder clay and possessing endless pools and marshes with, still, a good deal of consequent malarial trouble. The summers are warm in the lowland but the winters, generally, are sharp, the rainfall rises well above 1 metre per annum in the highland. The farms of Bresse are famous for pigs and poultry and the latter (especially geese) are also bred, in Dombes, which also raises horses In the Jura hill country, pastures feed sheep and cattle from which cheese is produced, while many slopes are well forested. Bresse produces considerable cereal and other crops but the rest of the department is thus concerned mainly with stock-raising or with activities connected with its forests (of fir and oak) or with extensions of the silk industry from Lyons just beyond the south-west corner of the department, thanks to the water power available from the rivers among the gorges of the limestone country. Bourg is the capital of the department; the four arrondissements of which take their names from Bourg, Belley (the seat of a bishop in the archiepiscopal province of Besançon) and Nantua. The departmental appeals are heard at the court of Lyons and the department is also under Lyons educationally. Bourg (*q.v.*) is a market town specially known in connection with the famous church of Brou, wrongly described in Arnold's well known poem as being in Savoy. Among silk towns one may mention Jujurieux, Tenay, St. Rambert, St. Bernard en Bugey; Bellegarde and St. Rambert make wood pulp; and Oyonnax, a rather larger town than several of the others, north of Nantua, makes articles in wood and horn and is specially well known for its combs. Seyssel, on the far east, yields asphalt and many parts of the department give building stones, cement or potter's clay. There is a good tourist industry for winter sports, angling, etc., and some of the gorges and ridges are very striking; near Bellegarde, at the Perte du Rhône, that great river formerly disappeared down a fissure. Though the main P.L.M. railway from Dijon to Lyons lies west of the Saône, and so outside the department, the main line from Paris to Geneva runs through Bourg and Ambérieu to Bellegarde; both the Saône and the Rhône are navigable for considerable lengths along the confines of the department.

**AINGER, ALFRED** (1837–1904), English divine and man of letters, was born in London on Feb. 9, 1837, the son of an architect. He was educated at King's College, London, and at Trinity College, Cambridge, and was ordained in 1860 to a curacy at Alrewas, near Rugeley. His connection with the Temple Church, in London, began in 1866, when he was appointed reader; and in 1894 he succeeded Dr. Vaughan as master. In 1887 he was presented to a canonry in Bristol cathedral, and he was chaplain-in-ordinary to Queen Victoria and King Edward VII. He died on Feb. 8, 1904. Canon Ainger's gentle wit and humour, his generosity and lovable disposition, endeared him to a wide circle. In literature his name is chiefly associated with his sympathetic appreciation of Charles Lamb and Thomas Hood.

His works include: *Charles Lamb* (1882) and *Crabbe* (1903) in the "English Men of Letters" series, editions of Lamb's *Essays of Elia* (1883) and of his *Letters* (1888; 2nd ed., 1904), of the *Poems* (1897) of Thomas Hood, with a biographical introduction; *The Life and Works of Charles Lamb* (1899–1900); articles on Tennyson and Du Maurier in the *Dictionary of National Biography; The Gospel and Human Life* (1904), sermons; *Lectures and Essays* (1905), edited by the Rev. H. C. Beeching

*See* Edith Sichel, *The Life and Letters of Canon Ainger* (1906).

**AINHARDUS:** *see* EINHARD.

**AINMÜLLER, MAXIMILIAN EMMANUEL** (1807–1870), German artist and glass-painter, was born at Munich on Feb. 14, 1807. In 1828 he was appointed director of the newly-founded royal painted-glass manufactory at Munich. The method which he gradually perfected there was a development of the enamel process adopted in the Renaissance, and consisted in actually painting the design upon the glass, which was subjected, as each colour was laid on, to carefully-adjusted heating. The earliest specimens of Ainmüller's work are to be found in the cathedral of Ratisbon. With a few exceptions, all the windows in Glasgow cathedral are from his hand. Specimens may also be seen in St. Paul's cathedral, and Peterhouse, Cambridge, and Cologne cathedral contains some of his finest productions. Ainmüller had considerable skill as an oil-painter, especially in interiors. He died on Dec. 9, 1870.

**AINSWORTH, HENRY** (1571–*c.* 1622), English Nonconformist divine and rabbinical scholar, was born at Swanton Morley, Norfolk. He was a scholar of Caius College, Cambridge, joined the Puritan party in the church, and eventually the Separatist. Driven abroad in the persecution of 1593, he found a home in "a blind lane at Amsterdam." He acted as "porter" to a scholarly bookseller in that city, who, on discovering his skill in Hebrew, enabled him to continue his Hebrew studies. When part of the London church, of which Francis Johnson (then in prison) was pastor, reassembled in Amsterdam, Ainsworth was chosen as their doctor or teacher.

In 1596 he drew up a confession of their faith, which he reissued in Latin in 1598. Johnson joined his flock in 1597, and in 1604 he and Ainsworth composed *An Apology or Defence of such true Christians as are commonly but unjustly called Brownists.* In 1610 he was forced reluctantly to withdraw, with a large part of their church, from Johnson and his adherents on a question of church government, Ainsworth taking the more congregational view. (*See* CONGREGATIONALISM.) But in spirit he remained a man of peace. The fruit of his rabbinical learning appeared in his *Annotations*—on *Genesis* (1616); *Exodus* (1617); *Leviticus* (1618); *Numbers* (1619); *Deuteronomy* (1619); *Psalms* (including a metrical version, 1612); *Song of Solomon* (1623). These were collected in folio in 1627, and again in 1639. From the outset the *Annotations* took a commanding place, especially among Continental scholars.

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**AINSWORTH, ROBERT** (1660–1743), English schoolmaster and author, was born at Eccles, near Manchester, in Sept. 1660. Ainsworth's name is associated with his Latin-English dictionary, begun in 1714 and published in 1736 as *Thesaurus linguae Latinae compendiarius.* He died in London, April 4, 1743.

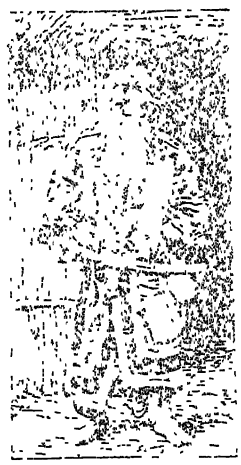
**AINSWORTH, WILLIAM HARRISON** (1805–1882), English novelist, was born at Manchester, Feb. 4, 1805. He was educated for the law, but at the age of 21 he married a daughter of John Ebers, the publisher, and followed his father-in-law's profession for a short time. A novel called *Sir John Chiverton,* in which he had a share, won the praise of Sir Walter Scott, and he turned to novel-writing. *Rookwood* (1834), with its description of the ride of Dick Turpin to York, had an immediate success. He published about 40 "historical" novels, of which the best known are *Jack Sheppard* (1839), *The Tower of London* (1840), *Old St Paul's* (1841) and *Windsor Castle* (1843). He edited *Bentley's Miscellany,* in which *Jack Sheppard* was published as a serial, and in 1842 he became proprietor of *Ainsworth's Magazine.* In 1853 it ceased to appear, and Ainsworth bought the *New Monthly Magazine.* He died at Reigate, Jan. 3, 1882.

*See* S. M. Ellis, *William Harrison Ainsworth and his Friends* (London, New York, 1911).

**AINTAB** or GAZIANTEB (anc. DOLICHE), a city of Anatolia, Turkey, just outside Syria, pop. (1940) 57,132 (two-thirds are Muslim, mainly of Turkoman origin and there are 15,000 Armenians). In ancient times (2nd Mil. B.C.) Aintab was in the Hittite area and is probably of Hittite origin. Duluk, the site of *Doliche,* famous for the worship of Zeus Dolichenus (Baal), is marked by a mound two hours distant to the northwest. In Crusading times its strong castle (*Hamtab*) was a strategic point of importance and was captured by Saladin in 1183. It served as the last base of Ibrahim Pasha before his victory over the Turks at Nezib, 25 mi. to the northeast (1839). In the winter of 1920–21 the armed opposition of the Turkish nationalists to the French occupation of north Syria centred in Aintab, which became the "Verdun of Anatolia." After an investment lasting six months, despite determined Turkish efforts to relieve it, the city surrendered to the French troops. France returned it to Turkey under the Angora treaty of Oct. 30, 1921.

The modern city stands high (3,500 ft.) in the open, treeless valley of the Sajur, a tributary of the Euphrates, some 65 mi. N.E. of Aleppo. Important educational and medical work is carried on by the American Mission Board in their college (founded 1874) and girls' seminary. There is also a Franciscan mission. Manufactures include striped dress materials (the chief of which is a mixture of silk and cotton), black goats' hair cloth for tents, morocco leather (*sakhtiyan*) made from goats' skins (it is estimated that nearly 400,000 are tanned here annually), "Aleppo soap" made from olive oil, *Pekmez,* a sweet paste made from grapes, and the dyeing of yarns. The exports include pistachio nuts, tobacco, cotton and cereals.

**AINU,** who are racially closely akin to, if not identical with, the Neolithic inhabitants of Japan (*see* JAPAN: *History*) are now very reduced in numbers and live in Hokkaido, the northern island of Japan, in part of Saghalien, and have kinsfolk in the Ryukyu archipelago (*q.v.*). They are dwindling fast and are unable to compete with the advance of Japanese civilization. Physically they are probably the remains of an old Proto-Nordic population once widely spread over Northern Asia, and are certainly the relics of a very old human stock. Their culture recalls in many ways stone age man and they have preserved the very earliest stage of agriculture, when the men are still hunters but the women have developed beyond the mere collecting stage and are beginning actually to plant crops.



AN AINU VILLAGE CHIEF
The Ainu are now under Japanese rule, but in former times their affairs were administered by hereditary chiefs, three in each village

The Ainu religion is closely akin to the animistic religion practised by various primitive peoples of northern Asia, and they are particularly liable to that peculiar kind of religious ecstasy known as Arctic hysteria. One of their special cults is that of the bear. This animal is caught as a cub, and is carefully tended by the women who will even suckle it. At about three years old the bear is sacrificed with elaborate ceremony. In most of the Ainu villages, the special wooden cages in which the bears are kept can be seen. Prominent also in the villages are sticks which have been whittled (*inao*) and the shavings left on. The sticks are stuck in the ground and have a religious significance.

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**AÏR,** a region lying between 15° and 19° N. and 6° and 10° E., and included in the province of Agades in Niger colony, French West Africa. It is one of several upland regions of the Sahara. It consists basically of broadly rounded, ancient granitic hills rising to an average elevation of 2,500 ft. These are overlaid by scattered lava flows and are crossed from east to west by wide, shallow valleys which are usually dry. Several volcanic ranges, reaching to 5,000-ft. elevation, rise with startling abruptness above the general level of the land. Because of elevation, Air is considerably more moist than most of the Sahara Rainfall at Agades in the lower, southern part of the region averages seven inches per year and is concentrated from May through September. Higher elevations receive more rain, but seasonal distribution is the same. Though there are no permanent rivers in Air, the valleys become broad, rapidly flowing streams several times during each rainy season. Most of the water runs off westward to the broad, lower plain of Talak where the soil moisture thus derived provides plentiful grass cover. A small amount drains eastward to disappear beneath the desert sands of Ténéré.

In contrast to the barren hill and mountain slopes, many of the valleys of Air are densely covered with brush and tree vegetation or grasses through which are scattered a few small trees.

In 1944, Aïr's population totalled about 20,000; that of Agades was about 3,200. The inhabitants are Tuareg, or Berbers, with a strong admixture of Negroid blood. These people are dominantly nomadic; yet they maintain permanent settlements which serve as market centres and caravan relay stations. Agriculture is unimportant, but camels, sheep and a few cattle are pastured.

Agades is the capital and is on the trans-Saharan bus route from Algiers to Zinder. Caravan routes, of which that eastward to the Bilma salt oasis is the most important, pass through the town Its population was greatest, more than 30,000, in 1591, but decline of caravan trade and treatment accorded the Tuareg by the French after the revolt of 1917 caused its modern decline.

**AIR,** the atmosphere that surrounds the earth. With the development of analytical and especially of pneumatic chemistry, the air was recognized not to be one homogeneous substance, as was long supposed, and different "airs," or gases, came to be distinguished. At the end of the 18th century oxygen gas was known as *dephlogisticated air,* nitrogen or azote as *phlogisticated air,* hydrogen as *inflammable air,* carbonic acid gas as *fixed air.* The name is now ordinarily restricted to atmospheric air (*see* ATMOSPHERE)

The sense of atmosphere or environment may have led to the further use of the word "air" to mean "manner" or "appearance"; and so to its employment (*cf.* Lat. *modus*) in music for "melody." (*See* ARIA.)

**AIRAY, HENRY** (1560?–1616), English Puritan theologian, was born at Kentmere, Westmorland, but no record remains of the date of either birth or baptism.

According to Anthony Wood's *Athenae,* Airay "was sent to St. Edmund's hall in 1579, aged nineteen or thereabouts. Soon after he was translated to Queen's College, where he became *pauper puer serviens;* that is, a poor serving child that waits on the fellows in the common hall at meals, and in their chambers, and does other servile work about the college." He was graduated from Queen's College as B A. on June 19, 1583; and, after receiving M.A. and B.D. degrees, he became D.D. at his college on June 17, 1600. "About the time he was master" (1586) "he entered holy orders, and became a frequent and zealous preacher in the university."

His *Commentary on the Epistle to the Philippians* (1618, reprinted 1864) is a specimen of his preaching before the college and his enunciation of Calvinism. In 1598 he was chosen college provost, and in 1606 he was vice-chancellor of the university. He was also rector of Otmore (or Otmoor) near Oxford.

He died on Oct. 6, 1616. His character as a man, preacher, theologian, and as an important ruler in the university, will be found portrayed in the Epistle by John Potter, prefixed to his *Commentary.* He must have been a fine specimen of the more cultured Puritans—possessed of a robust common sense in admirable contrast with some of his contemporaries.

**AIR BLADDER,** the name given to a structure present in all bony fishes (teleosts) and somewhat homologous with the lungs of land vertebrates The functions of this organ, which contains gas having a high percentage of oxygen, are obscure. hydrostatic uses are attributed to it, but its function doubtless varies. In some fishes (especially Siluroidea), it is connected with the internal ear by a chain of bones, the Weberian ossicles, and in these forms it is possibly concerned with hearing. It usually retains a connection with the alimentary canal (except in most Acanthopterygii, *q.v.*), but is normally dorsal to it (*See* FISHES.)

**AIRBRUSH,** a machine used for applying liquid colouring powders, flock, latex and glazes to a surface by means of compressed air The use of compressed air for the atomization of liquids has been known for many years, but it is only in the last 35 years that the principle has been successfully applied to the application of all types of coating materials in commercial and industrial enterprises, and today there is hardly an institution anywhere whose product requires finishing that does not employ this method of application. The early successful use of airbrushes was in the field of art for retouching, etc.

The airbrush shown in fig 1 (p. 447) is used in drawing the most delicate hairline work, as well as photographic retouching It is a common implement in all large newspaper art departments Fig. 2 illustrates the next step toward a commercial airbrush, this style being used for decorative and show-card work

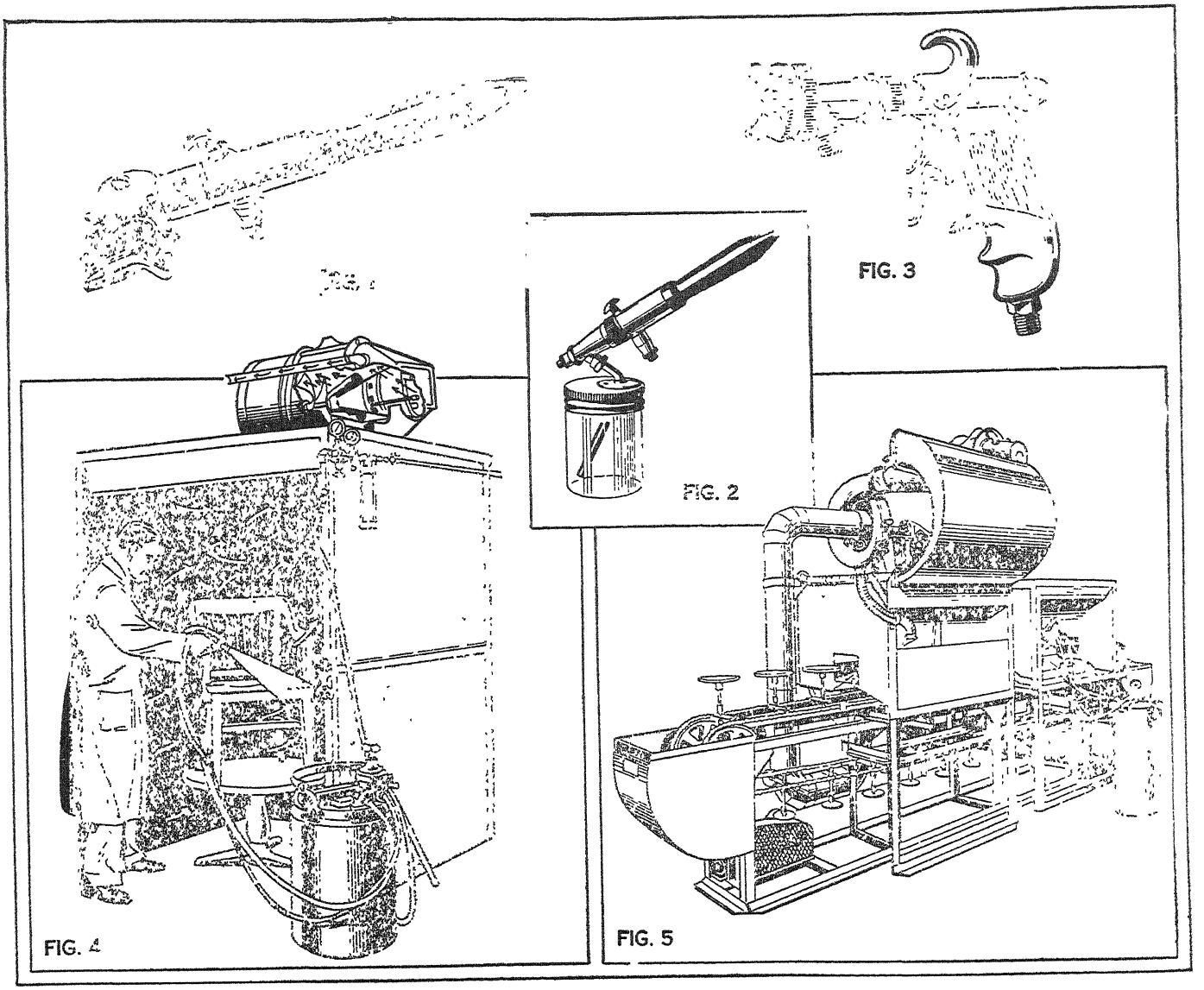
The natural evolution of the airbrush that was used by the artist brought about the present industrial type (fig. 3) which is used in practically every automobile and furniture factory, or any industry applying liquid finishes to their product This is a universal airbrush, inasmuch as it may be used with any style of fluid supply, gravity (overhead bucket), pressure tank and cup (either syphon or gravity), thus making the airbrush applicable to all purposes. The heads for this type are made in 12 sizes, all interchangeable, thus adapting the airbrush to all consistencies of material. The production of as many as 5,000 automobiles per day could never have been reached were it not for the airbrush, which makes it possible to coat a body in less than one minute. Fig. 4 shows an industrial installation as used for the finishing of furniture, the booth and ventilating equipment being very necessary to carry off the fumes and excess spray.

Fig. 5 illustrates an automatic adhesive and flocking unit such as used by largest industrial organizations for high-speed daily production. In this unit, the airbrushes are operated automatically. In the section to the right the automatic airbrush applies the adhesive or binder and in the second station at the left the specially designed airbrush applies the flock, the unit reclaiming all unused material. Daily production in eight hours is 11,000 disks. Contract painters and large railroad companies also use the airbrush for general painting on buildings and bridges, effecting large savings, in addition to the fact that they are able to do the work in season.

Portable air-painting units for both electric and gasoline (petrol) engine operation are universally selected for outside air-painting jobs. Airbrushes are now made to function in every capacity from that of a cement mixture to the most delicate art work.

**AIR CONDITIONING.** The term is derived from the word conditioning which was applied to the determination of the moisture content of textiles, and covers the treating of air in an enclosure to regulate its moisture content, temperature, purity and usually its circulation. For increasing human comfort and for the manufacturing or processing of certain materials, an accurate control of the moisture content of the air is most important. It is sometimes roughly effected by adding water vapour or mist directly to the enclosed air, but more precisely by using an air-conditioning apparatus by which the air is purified and its temperature and moisture definitely controlled before it is introduced into the space to be conditioned.

Originally only places where equable and moist climatic conditions prevail, such as Lancashire, Eng., and the Fall River district in Massachusetts, could be chosen for the building of cotton mills. Then moisture was added to the air by evaporating water in steam pots. This method sufficed for small mills but was inadequate in the larger mills because of the heat generated by the




BY COURTESY OF PAASCHE AIRBRUSH COMPANY

FIG. 1.—AIRBRUSH USED EXTENSIVELY BY COMMERCIAL ARTISTS. FIG. 2.—LARGER THAN THE AIRBRUSH IN FIGURE 1 AND DIFFERING CHIEFLY IN HAVING A LARGER COLOUR RESERVOIR. FIG. 3.—ONE TYPE OF INDUSTRIAL AIRBRUSH. FIG. 4.—MODERN INDUSTRIAL INSTALLATION USED FOR PAINTING FURNITURE. FIG. 5.—AUTOMATIC ADHESIVE AND FLOCKING UNIT

great concentration of machinery. In the latter half of the 19th century the direct introduction into the room of an atomized spray of water both cooled and moistened the air, thus making it practicable to spin fine cotton yarns in all climates. At about the same time moist air was supplied to malting floors by passing the air through coke filters over which water trickled, or through a large series of wetted baffle plates. In 1897 Joseph McCreary of Toledo, O., patented an air washer intended primarily for purifying the air, but incidentally it cooled it and increased the moisture content. In 1906 Stuart W. Cramer of Charlotte, N.C., and Willis H. Carrier of Buffalo, N.Y., working independently, made two important contributions to the art. Cramer automatically controlled humidity by a system which depended upon the relation between the wet- and dry-bulb temperatures. This was applied to the humidifying spray heads located in the room. Carrier devised the "dew point control," an improved form of air washer which not only brought the air to saturation, but also controlled automatically the temperature of such saturation, thus determining the moisture content of the air supplied.

**Types of Apparatus.**—Of the two main types of humidifiers, the direct spray type, which provides for the atomization of the water and its introduction directly into the room, is made in relatively small sizes. The nozzles or distributors are placed just below the ceiling, and provide for humidifying only. The saturated air type, on the other hand, introduces large volumes of saturated air at the required temperature.

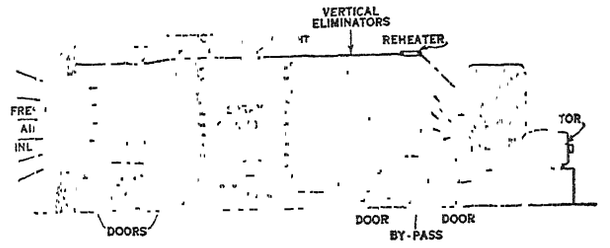
In the conditioning chamber this air is brought into intimate contact with water finely divided by spraying through special nozzles under moderate pressure. All of the free particles of water are then removed by an eliminator, which usually consists of a series of specially formed baffle plates on which all free particles of moisture are caught, leaving the air saturated but free of all suspended water particles. The spray water may be heated or cooled, and the temperature of the saturated air may be modified before passing it into the room at the theoretic dew point.

When it is desirable to remove dust, soot and pollen from air, several types of filters may be employed. The most general types are composed of frames packed with fibrous glass, steel wool or similar materials. These may be covered with a viscous oil to hold the particles of dust more firmly. Special filter paper, arranged in V's for greater surface, is also employed. Electrostatic precipitators are installed in many large air-conditioning systems. Where dust particles of the smallest sizes must be removed, a special filtering medium of asbestos-bearing paper, closely pleated and completely sealed at the edges to a frame, is used.

Thermostats usually control the temperature automatically, either by admission of steam or hot water to the air heaters or by regulating the supply of cold, dehumidified air. Hygrostats control the humidity by regulating the air dew point, by varying the air volume or by on-and-off operation of the direct sprays.

After air conditioning of small shops, restaurants and other places had become general by mid-20th century, air-conditioning units assembled at the factory were developed. These are complete with fans, heaters, cooling coils and filters enclosed in a cabinet. The development of safe refrigerants also made it possible to include the compressor and condenser within the cabinet or to install them in some near-by place.

The quantity of moisture which may remain in the vapour state in a unit volume of space is dependent only upon its temperature. The saturation pressure of water vapour is approximately doubled for each 20° F. rise in temperature; *i.e.*, the maximum vapour pressure increases approximately in a geometric ratio for equal increments of temperature. The relation of the weight of water vapour in the atmosphere to the weight of air varies approximately in accordance with Dalton's law of partial pressures. When




BY COURTESY OF COOLING AND AIR CONDITIONING CORPORATION

DESIGN OF AIR CONDITIONING APPARATUS FOR LARGE BUILDING

water is brought into contact with unsaturated air it evaporates If the air is the sole source of heat necessary to produce evaporation, an eventual equilibrium saturation temperature is established depending on the initial air temperature and its initial degree of saturation. The reduction in the sensible heat of the atmosphere is equalled by the latent heat of the acquired water vapour; the total heat remains constant. The equilibrium temperature of evaporation is observed with practical accuracy by a wet-bulb thermometer. The general formula based upon this heat balance was stated in W. H. Carrier, "Rational Psychrometric Formulae," *Trans. A.S.M.E.*, vol. xxxiii.

When unsaturated air is passed through an air washer and brought to saturation without changing the temperature of the spray water, it will be cooled to the temperature of evaporation (substantially, to the wet-bulb temperature of the entering air). For example, when the outside air is at 95° F., the average wet-bulb temperature will be approximately 75° F. and the air passing through a spray humidifier will be cooled to substantially 75° F. This method of cooling is especially valuable in textile mills and tobacco factories where the increased humidity as well as the lower temperature is desirable.

The temperature of evaporation is independent of the actual rate of evaporation. The rate of evaporation of water into air is dependent upon the air velocity over the water surface and upon the difference in vapour pressure existing between the water and the air. The determinations of these relationships have important applications in the drying of materials in air.

**Regain.**—The ratio of moisture content to the weight of dry material is technically termed regain and is characteristic of most organic materials. The regain for various materials varies widely, each having its own moisture of equilibrium depending principally on the relative humidity of the surrounding air and to a slight extent on the temperature. The amount of regain varies with the relative humidity. Materials such as natural silk, wool, cotton and synthetic yarns are sold on the basis of standard regain. These materials are finally processed in an atmosphere having a relative humidity corresponding to the standard regain.

**Comfort.**—The relation of moisture, heat and air motion to human comfort and physiological reactions was determined by research. These data were plotted as effective temperature lines of equal comfort sensation for different combinations of temperature, humidity and air motion. Complete air conditioning is necessary for comfort. Temperature control alone is not sufficient since humidity is important.

**Residences.**—During the heating season, the humidity within residences becomes very low This is especially true in homes with open fireplaces With low humidity, dust particles float in the air and are augmented by brittle fibres from clothing, carpets, books, etc. Approximately three-fourths to one gallon of water per 24 hr. evaporated per room is necessary to raise the humidity from 15% to 35% or 40%. Excessive humidity may cause condensation and dripping from the windows.

Humidifiers are built into many hot air central heating systems Complete year-around air conditioning units with heating and mechanical cooling have been installed in many homes Factory-assembled, single-room cooling units as well as humidifying units are available, and with steam or hot water heating systems an evaporating pan can be set in the floor.

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(W. H. CA.; A. E. STA.)

**AIRCRAFT CARRIERS.** With the exception of the amphibious craft developed in World War II, aircraft carriers represent the newest development in naval design. From the first experimental types built by both the United States and Great Britain late in World War I or soon thereafter, the carrier rapidly evolved into the queen of the battle line around which the U.S. navy built the fast carrier striking forces which swept Japanese air power from the skies and was a vital factor in winning the war in the Pacific.

Naval experiments with aircraft as a means of providing eyes for the fleet commenced early in the 20th century. The first flight of an aircraft from a U.S. naval vessel took place on Nov. 14, 1910, when Eugene Ely flew a Curtiss plane from a platform built on the bow of the cruiser "Birmingham," in Chesapeake bay. In January of the following year, in San Francisco, the same pilot landed a plane on a landing platform built on the stern of the U.S.S. "Pennsylvania" Ropes, stretched laterally across the landing platform, every three feet, had a 50-lb sand bag secured to each end, and were supported at a sufficient height from the deck to permit a hook on the plane to engage them. As the landing plane moved over the deck, it picked up an additional 100-lb. drag every three feet, thus being brought to a stop after travelling only a little more than half the length of the 120-ft. platform.

Experiments with shipboard aircraft were being carried out by Great Britain at approximately the same time, and in 1912 Commander C. R. Swanson flew a plane off H.M.S. "Hibernia." The following year the British flew seaplanes off the cruiser "Hermes," although the launching arrangement of small wheeled trucks supporting the plane resembled a catapult more than a flight deck. Three years later, the British completed a 250-ft. flight deck on the Cunard ship, "Campania," from which seaplanes were hoisted over the side into the water. While only one plane was flown off this model, the "Campania" introduced one feature common to all carriers since that time—an elevator which moved planes from the flight deck to a hangar space below, and brought them up again when flight operations were planned.

During the same period, tests were conducted with catapult launching of planes. A plane piloted by Theodore G. Ellyson was catapulted from an experimental model built at Annapolis, Md., in Nov. 1912, and in 1915 Comdr. Henry C. Mustin became the first person to make a catapult flight from a U.S. naval vessel when he was catapulted from the "North Carolina" in a Curtiss AB-2 flying boat. The U.S. cruisers "Seattle" and "Huntington" were fitted with catapults in 1916, and in 1917 these devices were capable of launching twin-float R-6 torpedo planes weighing 5,500 lb. The fact that such planes carried two 50-lb. bombs

indicated that naval minds, early alert to the possibilities of aerial reconnaissance, had also seized on the offensive uses of ship-borne planes. It is this feature of supplying wings to carry bombs and torpedoes to targets hundreds of miles away which eventually made the carrier the potent weapon it has become.

Actual operations of ship-borne planes during World War I were of slight importance. The U.S. cruiser "Huntington" carried catapult planes as submarine protection on convoy duty to Europe but the planes were not tried The British employed as many as four seaplane tenders during World War I; one was sunk, and one accompanied the British fleet when it met the German high seas fleet in the battle of Jutland, but was unable to provide the aerial observation of German fleet movements which could have given the British a decisive victory.

Profiting by this experience, the British completed, in 1918, a 300-ft flight deck on the "Furious," with no obstructions to hamper flight operations. In July of that year this ship made the first carrier raid in naval history by approaching to within 80 mi. of the German Zeppelin base at Tondern, from which point six Camels were launched in a foray which resulted in the destruction of the Zeppelins L54 and L60. With the Armistice, Britain announced the first flush deck carrier, "Argus," which featured a temporary "island" from which ship control and flight operations were directed, and the aircraft carrier as a type was established.

The first United States carrier, which began operations in 1922 was the "Langley," converted from the collier "Jupiter." (Long known as the "Covered Wagon," this ship was later converted to a seaplane tender which the Japanese sank off Java in 1942.) Five years later, the 33,000-ton giants "Lexington" and "Saratoga," built on battle cruiser hulls scrapped by the Washington naval treaty, joined the fleet, and in 1934, with the commissioning of the "Ranger," the U.S. navy had its first carrier built as such from the keel up. In the next 15 years more than 150 carriers of all types were built, either for use by the U.S. navy or for transfer to other nations.

**Carrier Aviation.**—Fleet employment of aircraft carriers covers two uses: as a fast striking force, and as an escort force. As the two terms imply, the functions are widely different and are usually performed by different classes of carriers.

The fast carriers, used both for offensive and defensive operations, observations of enemy fleet movements and shipping, and strikes against beach head targets, are primarily an offensive weapon. Built to provide mobility and flexibility of operation combined with strong aerial power and heavy defensive armament, the fast carriers are able to take aerial control of great sea areas and to harass and destroy enemy forces which may threaten friendly combatant fleets, merchant shipping or amphibious operations.

Fast carriers in 1950 were of two types, one carrying about 100 planes and the smaller, but equally fast, 33-plane ship. Fighter, dive bomber and torpedo bomber squadrons were organized in carrier air groups, whose operations were highly co-ordinated. Specialized groups consisting of night fighters and high-speed photo reconnaissance planes were also carried by fast carriers.

Wartime operation of such ships involved the task group of three to five carriers, supported by several battleships and cruisers and several divisions of destroyers, under one command. The fast carrier task force, such as task force 58 was composed of from two to five task groups. The striking power of such a force is illustrated by the fact that the first air assault on the Philippines in Sept. 1944 included 730 carrier planes, the task force which supported the Leyte landings a month later carried 1,060 planes and when task force 58 raided the Japanese home islands in Feb. 1945 the component carriers were able to put 1,220 planes in the air.

Escort carriers are slower, smaller ships, carrying about 30 planes, including fighters and torpedo bombers. The escort carriers, when organized as a force, provided air and anti-submarine defense for invasion convoys and beach head areas, and furnished aerial support for invasion troops until such time as conditions permitted the employment of land-based planes. Usually four to seven such carriers, with about twice as many escorting destroyers were assigned to support amphibious operations, but these carriers did operate individually in certain phases of anti-submarine warfare and escort duties.

**Tactical Effectiveness of Carriers.**—Any discussion of the value of the carrier in fleet operations must be based on the assumption that the term carrier includes such a ship with her aircraft embarked in fighting readiness. The first step in winning control of the sea is to take control of the air above it, and the carrier's high mobility permits it to be quickly placed in the area where air control is desired, while its offensive power, figured in aircraft, enables it to take control of the air in the face of the most persistent and continued resistance.

An early example of the value of air control was the German loss of the "Bismarck" in 1941, when the presence of H M S "Victorious" and "Ark Royal" allowed the British to put up sufficient planes to slow her to the point where battleships could close in for the kill. Later, in Dec. 1941, through lack of aerial control, Britain lost the "Prince of Wales" and "Repulse" to Japanese aircraft in the South China sea in an engagement lasting only two hours. Again, although this action took place in the straits of Dover within range of hundreds of R A.F. land-based planes, Britain lost an opportunity to sink the German "Gneisenau," "Scharnhorst" and "Prinz Eugen" because the Germans maintained aerial control of the immediate area with a heavy cover of fighters.

A special factor in control of the air is the ability to exercise control at all times, as was learned by the United States in 1943

*Aircraft Carrier Losses in World War II—All Nations*

| Name | Tonnage | Date | Place | Cause |
|---|---|---|---|---|
| UNITED STATES | | | | |
| Lexington | 33,000 | May 8, 1942 | Coral sea | Fire—sunk by U S. |
| Yorktown | 19,900 | June 7, 1942 | Midway | Submarine torpedoes |
| Wasp | 14,700 | Sept 15, 1942 | Solomons | Submarine torpedoes |
| Hornet | 19,800 | Oct 26, 1942 | Santa Cruz I | Fire—sunk by U S |
| Liscome Bay | 6,730 | Nov 24, 1943 | Tarawa I | Submarine torpedoes |
| Block Island | 6,730 | May 29, 1944 | Atlantic O | Submarine torpedoes |
| Princeton | 11,000 | Oct 24, 1944 | Leyte gulf | Damaged by Japanese shore-based aircraft—sunk by U S |
| Saint Lo | 6,730 | Oct 25, 1944 | Leyte gulf | |
| Gambier Bay | 6,730 | Oct 25, 1944 | Leyte gulf | by surface ships |
| Ommaney Bay | 6,730 | Jan. 4, 1945 | Lingayen gulf | Japanese aircraft |
| Bismarck Sea | 6,730 | Feb. 21, 1945 | Iwo Jima | Japanese aircraft |
| GREAT BRITAIN | | | | |
| Courageous | 22,500 | Sept 17, 1939 | Atlantic O | Submarine torpedoes |
| Glorious | 22,500 | June 8, 1940 | Off Norway | Surface action |
| Ark Royal | 22,000 | Nov. 14, 1941 | | Submarine torpedoes |
| Audacity | 5,537 | Dec 21, 1941 | | Submarine torpedoes |
| Hermes | 10,850 | April 9, 1942 | | Japanese aircraft |
| Eagle | 22,600 | Aug 11, 1942 | | |
| Avenger | 12,000 | Nov. 15, 1942 | Gibraltar | |
| Dasher | 12,000 | March 27, 1943 | Firth of Clyde | |
| Nabob | 13,785 | Aug 22, 1944 | North Cape | |
| Thane | 13,785 | Jan 15, 1945 | The Clyde | |
| JAPAN | | | | |
| Shoho | 12,000 | May 7, 1942 | Coral sea | U S carrier planes |
| Hiryu | 17,500 | June 4, 1942 | Midway | U.S carrier planes |
| Akagi | 36,000 | June 4, 1942 | Midway | U S carrier planes |
| Kaga | 35,000 | June 4, 1942 | Midway | U S carrier planes |
| Soryu | 17,500 | June 4, 1942 | Midway | U S carrier planes and submarines |
| Ryujo | 8,500 | Aug 24, 1942 | Solomons | U S carrier planes |
| Chuyo | 20,000 | Dec. 4, 1943 | Off Honshu | U S submarine torpedoes |
| Shokaku | 30,000 | June 19, 1944 | Off Yap I | U S submarine torpedoes |
| Taiho | 31,000 | June 19, 1944 | Off Yap I. | U S submarine torpedoes |
| Hitaka. | 28,000 | June 20, 1944 | Philippine sea | U S carrier planes |
| Otaka | 20,000 | Aug 18, 1944 | Luzon | U S submarine torpedoes |
| Unyo | 20,000 | Sept. 16, 1944 | China sea | U S submarine torpedoes |
| Zuiho | 12,000 | Oct 25, 1944 | Luzon | U S carrier planes |
| Zukaku | 30,000 | Oct. 25, 1944 | Luzon | U S carrier planes |
| Chitose | 11,000 | Oct. 25, 1944 | Luzon | U S carrier planes and surface craft |
| Chiyoda | 11,000 | Oct 25, 1944 | Luzon | U S. carrier planes |
| Jinyo | 21,000 | Nov. 17, 1944 | Yellow sea | U S submarine torpedoes |
| Shinano | 59,000 | Nov. 29, 1944 | Off Honshu | U S submarine torpedoes |
| Unryu | 18,500 | Dec. 19, 1944 | China sea | U.S submarine torpedoes |
| Kaiyo | 17,000 | July 24, 1945 | Japan | U S carrier planes and Army |
| Amagi | 18,500 | July | Japan | U S |

Note: All U S carriers sunk by Japan with exception of "Block Island", all British carriers sunk by Germany and Italy with exception of Illustrious, all Japanese carriers sunk by U S. losses from various official U S navy reports, also on British losses from *Jane's Fighting Ships, 1944-45*, Sampson Low, Marston & Co Ltd. (London, 1945), right on Japanese losses from U.S. Joint Army-Navy Assessment Committee, *Japanese Naval and Merchant Shipping Losses During World War II By All Causes* (Feb. 1947).

when the Japanese began to stress night torpedo attacks. The U.S. navy equipped carrier-type Hellcats and Corsairs with instruments for night fighting, and was conducting effective night-fighting operations from all carriers before the army land-based Black Widow night fighter reached the theatre. Night-fighting Hellcats alone accounted for 163 enemy planes with only three losses.

Possibly the best indication of the tactical effectiveness of carriers lies in the figures on Japanese shipping losses prepared by the Joint Army-Navy Assessment committee, on the basis of official Japanese documents. These figures, covering the entire period of hostilities, and compiled for all Japanese naval vessels and merchant ships of more than 500 tons, reveal that U.S. forces sank a total of 2,728 ships with a tonnage of 9,736,068. More than half the total was accounted for by U.S. submarines, but of the remainder, 520 ships displacing 2,101,477 tons were sunk by carrier aircraft. In addition, carrier aircraft in combination with other planes or vessels sank another 35 ships totalling 210,085 tons.

**Carrier War in the Pacific.**—Hostilities between the United States and Japan commenced with a well-planned and -executed Japanese carrier raid on Pearl Harbor the morning of Dec. 7, 1941, resulting in the complete loss of two U.S. battleships and immobilization of others for many months. Emphasis on carrier warfare was indicated by the fact that attacking Japanese pilots expected to find two U.S. aircraft carriers in the harbour and consequently pressed home a fierce attack on other ships which were in the usual carrier berths.

The next phase of the carrier war was the February to April series of diversionary raids by fast U.S. carriers in the Gilbert and Marshall Islands, Wake Island, Marcus Island and New Guinea, plus the famous Tokyo raid by Gen. James Doolittle leading a group of planes flown off the "Hornet." This phase was followed by the Coral sea battle which occupies a unique place in naval history in that it was the world's first major naval engagement in which opposing ships did not exchange a single shot.

In June 1942, U.S. and Japanese forces again met in the battle of Midway. While the United States lost one carrier, Japan lost four; this marked the first Japanese naval defeat in 350 years, ended its offensive action in the Pacific, and so reduced Japanese aerial power that its carriers were not again encountered in numbers for almost a year. During that time, U.S. carriers, in increasing numbers, continued strikes against enemy island bases, ending the year of 1943 with an 11-ship strike against the Gilbert and Marshall Islands.

Increased carrier warfare in 1944 resulted in 4 U.S. carriers being lost against 12 Japanese carriers sunk, and reached a culmination in the October battle of Leyte gulf, when U.S. carrier planes alone sank 4 Japanese carriers, 1 battleship, 2 light cruisers and 5 destroyers, besides assisting in the destruction of many others. At this point, the Japanese navy ceased to exist as a fighting force and control of the air passed to the United States.

Until the war ended, fast carrier striking forces ranged the western Pacific at will; in January they raided Formosa, Luzon, French Indo-China, Hong Kong, Canton, Okinawa and the Ryukyus; Tokyo was hit in February, the Inland sea in March and the China sea in April. Raids on the empire continued until the war was officially ended. In 44 months of carrier warfare, the United States lost 138,000 tons of carriers against 483,000 tons for Japan; for 451 carrier planes lost in air-to-air combat there were destroyed 6,444 Japanese planes in air combat plus 5,824 more destroyed on the ground.

**Postwar Carrier Disposition and Employment.**—With the cessation of hostilities in 1945, the immense carrier fleet of the U S. navy was no longer required, and approximately 75 carriers were placed in reserve in the "mothball fleets." This involved maintaining the ships in a state of preservation such that they might be quickly placed in operation again when needed Others, particularly those converted to naval use from merchant ship hulls, were sold as being in excess of naval needs, and some of these again were converted for various commercial purposes.

Of the carriers in active service with the fleet, some were undergoing extensive modifications to fit them for use with heavier and larger planes in use, such as the Douglas Skyraider, with a wingspread of 50 ft. and weight of more than 10 tons, and the Martin Mauler, of similar size but weighing more than 12 tons loaded.

While continuing the tactical development of carrier aviation, carriers in commission also served as a testing ground for evaluation of new types of planes, and as a means of keeping in training the thousands of naval reserve flight personnel

Postwar carrier operations also stressed the employment of carriers in "hunter-killer teams," an exclusive development of anti-submarine warfare, in which several destroyers act as the hunter of a submarine while the carrier planes perform the actual kill.

**Carrier Description.**—Since an aircraft carrier's one purpose is to carry planes, the landing platform, or flight deck, is the most outstanding feature of the ship. Varying in width from more than 60 to more than 100 ft., and in length from 500 ft. to almost 900 ft., it provides a miniature airport on which planes land, are fueled and armed, and take off A series of steel cables extend athwartships over the after portion; these are lifted mechanically when a plane lands, and as a hook dropped from the plane's tail engages one of the arresting cables, hydraulic brake drums on either end deccelerate the plane to a stop. In take-off, planes taxi off the forward end of the deck until airborne, although catapults built flush in the deck can be used when necessary, and jet-assisted take-offs were used for particularly heavy planes, such as the Martin Mariners flown off a carrier in Operation "Highjump" in Antarctica in 1947.

One or more elevators carry planes to and from the hangar deck, an open space almost as wide and long as the flight deck, where planes are parked when not immediately needed. As many as 200 planes can be carried in hangar and flight deck stowage by large carriers in "ferry" service. In the great hangar deck space, crews load bombs, torpedoes and ammunition, and gasoline into the planes, and perform overhaul and repair work as required. The hangar deck is, essentially, the true upper deck surface of the ship; beneath it are the living quarters, shops, storerooms, and engineering spaces common to all ships. Many carriers are, under the skin, sisters to various other types of ships; the "Independence" class carriers were built on the hulls of "Cleveland" class cruisers; the "Sangamon" class carriers were converted from oil tankers, and the "Bogue" class carriers were converted from maritime commission $C_3$ hulls.

In order to attain their high speed, carriers are built with little or no armour, sacrificing such equivalent weight for the flight deck and an immense load of gasoline, bombs, torpedoes, fuel oil, spare parts and the stores and provisions with which to maintain as many as 3,000 men for an extended period. Some protection is offered by 5-in. guns and the many smaller automatic guns, but the carrier's chief defense is her speed and the firepower of such of her own planes as can be employed in defensive operations.

The vital nerve centres of a carrier are centred in the island, the only part of the superstructure extending above the flight deck. Here the ship is controlled and operated, and here all flight operations are handled. The island is located on the right-hand side of the flight deck in all aircraft carriers, except for the Japanese "Kaiyo" and "Hosyo," which were built without islands. Due to the din of dozens of motors connected with any flight operation, spoken conversation is practically impossible, and various hand signals are used by plane crews and plane handlers, although orders from the island can be given to the flight deck with a "bull horn," an electrical amplifier capable of magnifying the voice hundreds of times. To eliminate confusion among the many men working on the flight deck during operations, the men in each "gang" performing a specific task wear jerseys of a distinctive colour.

The actual landing of the planes aboard the carrier is under the control of one officer stationed at the after end of the flight deck. Highly experienced in the operation of carrier aircraft, he watches the approach of each plane, indicating to the pilot through a series of hand signals the proper moves to make in bringing the plane in to a landing. At any time the landing officer judges the approach unsafe, he waves the plane off and the pilot withdraws

into the landing circle of other planes to await his turn to come in for another landing

**Types of Carrier Planes.**—Carrier planes in 1950 were of three major types fighters, dive bombers, and torpedo planes Fighter planes, designed for combat with enemy aircraft, were armed with machine guns and rockets; these with bombs, were also used against ships and land targets. Wartime carrier fighters were either Corsairs, Wildcats or Hellcats; types employed later included the jet-engined Cutlass and Sky Knight.

Dive bombers, as the name implies, dropped their bombs at the end of a dive, from extremely low levels, thus obtaining great accuracy. Such attacks were usually made in co-ordination with fighters and torpedo bombers as a triple threat offense. The early World War II dive bomber was the Douglas Dauntless, followed by the Curtis Helldivers. Torpedo bombers were Douglas Devastators and later, Grumman Avengers, carrying either a torpedo, a ton of bombs, depth charges or mines. Postwar planes of this class, classified as "attack planes," included the Douglas Skyraider and Martin Mauler. The twin-engined Lockheed Neptune patrol plane was also being modified for carrier operations.

(A. S. L.)

**AIRD, SIR JOHN,** 1ST BART. (1833–1911), British engineer, was born in London Dec. 3, 1833, the only child of John Aird, contractor for gas and water plants. He joined his father's business at 18, and was entrusted with the removal of the Crystal Palace buildings from Hyde Park and their re-erection at Sydenham.

He took part in many enterprises, such as the Hampton and Staines reservoirs, the waterworks of Amsterdam, Copenhagen, Moscow, Bahia, Pará, Calcutta, Simla and Berlin, and later (in the joint firm of Lucas and Aird, afterward John Aird and Co.) St. John's Wood railway, Hull and Barnsley railway and docks, the W. Highland railway and the great Aswan dam across the Nile. He represented N. Paddington in parliament as a Unionist from 1887 to 1905, and was its first mayor in 1900. In 1901 he was created a baronet. He made a fine collection of pictures by British painters, the illustrated catalogue to which was printed in 1884. He died at Beaconsfield, Bucks., Jan. 6, 1911.

**AIRD,** THOMAS (1802–76), Scottish poet, and journalist, was born at Bowden, Roxburghshire, on Aug. 28, 1802, and died at Dumfries on April 25, 1876. He was educated at Edinburgh university, where he made the acquaintance of Thomas Carlyle and James Hogg, and he decided to devote himself to literary work. He published *Martzoufle, a Tragedy, with other Poems* (1826), a volume of essays and a long narrative poem in several cantos, *The Captive of Fez* (1830).

For a year he edited the *Edinburgh Weekly Journal,* and for 28 years the *Dumfriesshire and Galloway Herald.* In 1848 he published a collected edition of his poems, which met with much favour. Carlyle said that he found in them "a healthy breath as of mountain breezes." Among Aird's other friends were Thomas de Quincey, John Gibson Lockhart, Arthur Penrhyn Stanley (afterwards dean of Westminster) and William Motherwell.

*See* a "Life" by J. Wallace prefixed to the 5th edition (1848) of his *Poems.*

**AIRDRIE,** a large burgh of Lanarkshire, Scotland. Pop. (est. 1938) 28,134. Area, 3.23 sq.mi. It is 11 mi. E. of Glasgow by the Scottish region railway, and connects with Glasgow by the Monkland canal, as well as by the Scottish region railway via Coatbridge and Whifflet. The canal (constructed 1761–90) connects with the Forth and Clyde canal near Maryhill. Airdrie was a market town in 1695; its later prosperity was due to coal and iron beds. Industries are boilermaking, sanitary engineering, iron and brass founding, general engineering, railway carmaking and cotton manufacturing.

The burgh was the first town in Scotland to adopt the Free Library act. Airdrie unites with Coatbridge in sending one member to parliament. The parish of New Monkland, in which Airdrie lies, was formed (with Old Monkland) in 1640 out of the barony of Monkland, land granted by Malcolm IV to the monks of Newbattle.

**AIRE,** a town of north France, on the Lys, in the department of Pas-de-Calais, 12 mi. S.S.E. of St. Omer by rail. Pop. (1946) 5,194. The town lies in a low and marshy situation at the junction of three canals. In the middle ages Aire belonged to the counts of Flanders, and a charter (1188) is still extant. It was given to France by the Peace of Utrecht (1713).

The church of St Pierre (15th and 16th centuries) shows three stages of Gothic architecture. The hôtel-de-ville is 18th century. Aire has considerable trade in agricultural produce In World War I it was one of the headquarters of the British army (1917–18).

**AIRE,** a town of southwest France, in the department of Landes, on the Adour, 22 mi S E of Mont-de-Marsan on the railway between Morcenx and Tarbes. Pop. (1946) 2,974 Aire (*Atura, Vicus Julii*) was the residence of the kings of the Visigoths, one of whom, Alaric II (*q v* ), there drew up his famous code

It is the seat of a bishopric dating from the 5th century, and has a cathedral of the 12th century and an episcopal palace of the 11th, 17th and 18th centuries. Both have undergone frequent restoration. They are surpassed in interest by the church of St Quitterie in Mas d'Aire, the suburb southwest of the town The latter is a brick building of the 13th and 14th centuries, with a choir in the Romanesque style, and a fine western portal which became much disfigured. The crypt contains several Gallo-Roman tombs and the sarcophagus (5th century) of St. Quitterie

**AIR ENGINE.** The practical drawbacks to employing air as the expanding substance of a heat engine are so great that its use has been very limited. Such attempts as have been made to design air engines on a large scale have been practical failures, and are now interesting only as steps in the historical development of applied thermodynamics. In the form of domestic motors, air engines had some application, prior to the development of the internal combustion engine and the extended use of electricity. The type survives in a few motors of very small power. One of the chief practical objections to air engines is the great bulk of the working substance in relation to the amount of heat that is utilized in the working of the engine. Another is the difficulty of getting heat into the working air through the walls of the containing vessel.

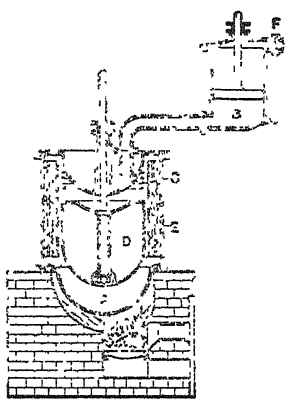



FIG 1.—STIRLING'S AIR ENGINE

The working parts shown are:

A. Externally fired heating vessel
3. Working cylinder
C. Cooling pipes
D. Displacer
E. Regenerator
F. Connecting flange to another heating vessel

Air takes up heat from such a surface with much less readiness than does water. The waste of heat in the chimney gases is accordingly greater; and further, the metallic shell is liable to be quickly burned away as a result of its contact at a high temperature with free oxygen. The temperature of the shell is much higher than that of a steam boiler, for in order to secure that the working air will take up a fair amount of heat, the upper limit to which its temperature is raised greatly exceeds that of even high-pressure steam.

A form of air engine invented in 1827 by the Rev. R. Stirling is of special interest as embodying the earliest application of what is known as the "regenerative" principle, namely, the principle that heat may be deposited by a substance at one stage of its action and taken up again at another stage with but little loss, and with a great resulting change in the temperature of the substance at each of the two stages in the operation.

The principle has since found wide application in metallurgical and other operations. In any heat engine it is essential that the working substance should be at a high temperature while it is taking in heat, and at a relatively low temperature while it is rejecting heat.

An attempt to develop a powerful air engine was made in the

ment of the atomic bomb, with its infinitely great destructive power as compared with ordinary high explosive, was likely to have the effect of cutting down both the number and size of bombers employed.

It might well be that the air forces which had been developed from the flimsy reconnaissance machines of 1914 to the jet fighters and superheavy bombers were already obsolescent a few years after World War II, and that the next air weapons might be pilotless craft controlled from the ground and carrying destructive loads more powerful than anything yet envisaged. In that event, the whole theory and practice of warfare might change once again. (D. Cr.)

## UNITED STATES

When the United States entered World War I, little had been done toward giving the aviation section of the army's signal corps either adequate equipment or trained personnel, and its record of participation in the punitive expedition into Mexico (in its only previous combat operation) was one of dismal failure. In 1917 congress authorized an increase in personnel and appropriated $640,000,000 for procurement of aircraft and for the support of the augmented aviation section, which now expanded rapidly from a personnel strength of 131 officers (of whom 78 were pilots) and 1,120 enlisted men in 7 squadrons (in April 1917) to 20,000 officers, 600 cadets and 164,000 men in 7 squadrons (in Nov. 1918). Aviation served successfully as the "eyes of the armies" as hostilities deteriorated into the long stalemate of trench warfare. A force of 1,481 planes—U.S., British and French—under the command of Col. William L. ("Billy") Mitchell took part in the St. Mihiel offensive of Sept. 1918, without producing decisive action. But World War I gave early training to future air leaders, revealed the potentialities of aviation for strategic as well as tactical reconnaissance, hastened the technical developments of aeronautics and pointed the way to the future use of air power in strategic bombardment.

The Army Reorganization act of 1920 established the renamed air service as a separate and co-ordinate arm of the army with an authorized strength of 1,516 officers and 16,000 enlisted men. The air service now concentrated on the progressive development and improvement of planes and motors built according to new and better designs. Experiments were made with the use of dirigibles, but they did not prove successful. Notable early records for distance, speed and endurance were achieved

The Air Corps act of 1926 gave the air service a new name, and by provisions affecting personnel and procurement sought "to provide more effectively for the national defense by increasing the efficiency of the Air Corps." On June 20, 1941, the army air forces was established and—particularly as a result of reorganization announced March 2, 1942—achieved *de facto* autonomy, absorbing for all practical purposes the army air corps.

World War II saw the development of the use and the maturing of the strategic concept of air power. Tactical air power co-operated with the army and the navy to win victories in the invasion of North Africa in Nov. 1942, as it was to do later in the invasion of Normandy in the summer of 1944. But independent action of the A.A.F. (in co-operation with the R.A.F.) in long-range, strategic bombardment (chiefly by B-17s) did much to destroy and dislocate the German military, industrial and economic system and to undermine the morale of the German people to the point where their capacity for armed resistance was fatally weakened. Particularly notable was the destruction of the German fighter defense, beginning in July 1943 and culminating in the "Big Week" of Feb. 20, 1944, when six days of perfect flying weather permitted 8th bomber forces almost all on the widely-dispersed German air-frame factories and assembly plants. The German aircraft industry never fully recovered from the blow, and the Allies controlled the air over Europe during the remaining 14 months of the war.

In the Pacific the A.A.F. won its initial victories in the China-Burma-India theatre giving substantial protection against Japanese forces and disrupting the Japanese shipping and railways. It transported men and supplies for all U.S. forces, and in its flight from bases in India over the "Hump" of the Himalaya to China performed a logistic air feat previously unparalleled, that kept China in the war. Co-operating with navy and marine air forces, it assured air superiority in the push toward Okinawa, and finally, when B-29s dropped single atomic bombs on Hiroshima and Nagasaki on Aug. 6 and 9, 1945, it deepened the conviction of the Japanese people that surrender was inevitable.

After the surrender of Japan the A.A.F. shrank rapidly from its wartime peak of 2,400,000 men and officers and 80,000 planes to a low point of 303,614 military personnel in May 1947. Hasty demobilization weakened the training facilities of the air force and reduced the force to such a low state in operational efficiency that there was deep concern for its capabilities. Anticipating the eventual enactment of legislation to establish an autonomous air force within a unified defense establishment and taking heed of lessons learned during the war, the air force reorganized its structure into functional commands to replace the previous organization based on geographical or area responsibility, or on the type of aircraft employed, and reorganized its headquarters functionally as well. The command structure that became effective June 11, 1946, was retained when autonomy was achieved, and the United States air force came into existence Sept. 18, 1947.

Of the three military services, the air force at mid-century had primary interest in operations in the air and had the responsibility, assigned by the joint chiefs of staff, of being organized, trained and equipped for prompt and sustained combat operations. There were two combat commands, eight supporting commands (which for the most part performed functions implicit in their names) and five commands overseas. The continental air command combined the former air defense command and tactical air command into a continental defense command, while the strategic air command trained primarily for long-range operations in any part of the world at any time, either independently or in co-operation with land and naval forces. The air matériel command, the air proving ground and the air training command lent direct support, while the Air university provided the training of staff and command officers. The military air transport service, a joint operation with the navy for which the air force had responsibility, provided air transportation for personnel and cargo of all agencies of the department of defense. The air force special weapons command was responsible for the service and development testing, within the field of air force interest and responsibility, of equipment and techniques relating to atomic energy. The research and development command (established Jan. 1950) had supervision of all U.S.A.F. field activities supporting research and development. The headquarters command supported the air staff.

The Alaskan air command and the Caribbean air command remained essential to hemispheric defense. The United States air forces in Europe and the far east air forces had occupational duties. The 3rd air division, raised to command status in Jan. 1949 with headquarters in England, supported air force activities overseas.

The necessity of performing the air lift supply of about 2,250,000 people in Berlin from June 26, 1948, to Sept. 30, 1949, proved a diversion from the air force's main task of rebuilding operational effectiveness, but provided opportunities that in the end contributed notably to the development of techniques and to the refinement of the total operational activity. In the "Good Friday" lift of mid-April 1949, 12,941 tons of food, clothing, fuel and other supplies were flown in to the beleaguered city in 24 hr. Almost 2,500,000 tons of supplies were carried in the 15 months of air lift in an unexcelled air logistics feat.

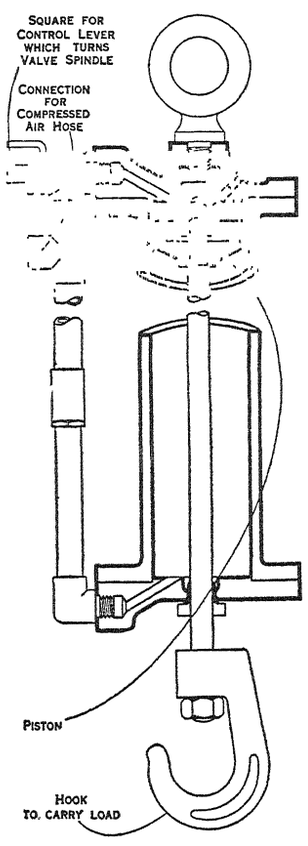
The attention to research and development which had characterized U.S. military aviation from its inception in 1907 was considerably increased after World War II and led to the rapid development of jet and rocket air power; to development of the long-range intercontinental bomber, the B-36; to establishment of records for long-range, high altitude and speed flights; and to notable experiments with guided missiles, which had been only slightly developed at the close of World War II. Particularly significant as pointing the way to future experiments and developments, and use of air power, were the many flights of the X-1

research aircraft after Oct. 1947 at a speed hundreds of miles in excess of the speed of sound (760 mi per hour at sea level) and the flights of a C-54 transport aircraft across the Atlantic, under the control of a mechanical automatic "pilot," in the fall of 1947.

**AIR GAS:** *see* GASOLINE PRESSURE APPLIANCES.

**AIR GUN,** a gun in which the force employed to propel the bullet is the elasticity of compressed atmospheric air. It has attached to it, or constructed in it, a reservoir of compressed air, a portion of which, liberated into the space behind the bullet when the trigger is pulled, propels the bullet from the barrel by its expansion. The common forms of air gun, which are merely toys, are charged by compressing a spiral spring, one end of which forms a piston working in a cylinder; when released by a pull on the trigger, this spring expands, and the air forces out the bullet.

**AIR HOIST.** In factories and other places where a supply of compressed air is available, its use for operating lifting tackle is much favoured, because of the cleanliness, absence of noise and ease of connection with flexible hose. The direct hoist, raising a load 4 or 5 ft., and dealing with from 100 to 7,000 lb in different sizes, is the simplest. It comprises a cylinder, a piston, a rod attached thereto and carrying the lifting hook at the bottom and an operating valve, controlled by pendant chains. An eyebolt at the top affords means of suspension to a fixed beam, or a swinging jib, or to a trolley running on a girder, either stationary or forming part of a jib or travelling crane.




WORKING PARTS OF AN AIR HOIST

The hoist is suspended from the eye at the top and the load is slung on the hook. The piston is shown at the top of the chamber, it having been forced upward to the full length of its stroke by the pressure of the air from below

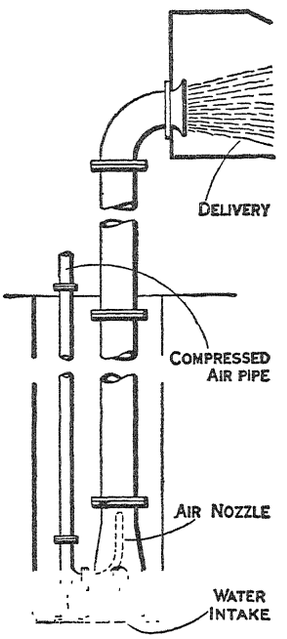
The hoist shown in the diagram is controlled by balanced pressure. The full air pressure of 100 lb. per square inch is maintained at the underside of the piston throughout all the operations of lifting, lowering and remaining stationary. For lifting, the attendant manipulates the valve so that air leaks off the top piston.

Another way of applying air power is to use a [illegible] valley block to which is [illegible] small pneumatic motor, the cylinders of which actuate connecting rods and so drive a crankshaft, this being geared to the rope drum in order to gain power. Loads up to ten tons can be lifted in this way.

For colliery service, another class of air hoist is built, a winch or haulage engine, the rope drum being driven through gears from a pneumatic motor. This is essential in circumstances where compressed air is the power supply in use. Some of the engines can be run either with air or steam.

**AIR LAW:** *see* AERIAL LAW.

**AIR LIFT,** a system of lifting liquids by compressed air without a pump. For artesian wells the method consists in carrying down a smaller air pipe either within the water delivery pipe or alongside it and connecting an air compressor. The compressed air forms with the water a mixture of lower specific gravity than the surrounding water in the well or bore hole, with the result that the mixture of air and water in the tube is forced by the weight of the surrounding water to the point of discharge (*see* figure). When the supply flowing into a well is not enough to give constant delivery, waste of energy may be avoided by a governor. Some air lifts yield as many as 285,000 gal. per hour per well. The Shone ejector, another form of air lift, is used for raising sewage and other liquids automatically from one or any number of points, and forcing to any spot desired. The difference between this and the well lift just described is that the liquid gravitates into a bell-shaped casting through an inlet pipe and rises until the vessel is nearly full. Then the air trapped at the top becomes slightly compressed and acts on a metal cup that lifts a valve and admits a supply of compressed air into the vessel. This drives the sewage out through an outlet pipe to reach a higher level or any distance away; a fresh supply enters through the inlet pipe which has been [illegible] during the discharge, and the cycle commences again.

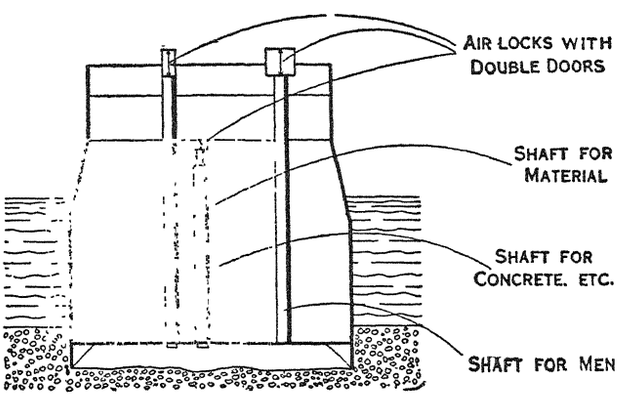



THE OPERATION OF AN AIR LIFT

The diagram shows water being forced up from a well by compressed air. Although chiefly supplied to wells and for lifting sewage, the method can be also used for moving acids, sludges, slimes and heavier liquids

**AIR LIFT (BERLIN).** On June 26, 1948, an intensive air cargo operation was launched by the United States and Great Britain to offset a soviet land blockade of Berlin from western Europe. The blockade was aimed at wresting the western (U.S., British, French) sectors of Berlin from the control of the three western powers. It lasted 10½ months, to May 12, 1949, with a tapering off period ended Sept. 30. During the total period, the 2,500,000 inhabitants of the western sectors were supplied with 2,323,738 tons of food, coal, machinery and other necessities (1,783,826 tons by U.S. planes, 538,416 by British), at a cost, to May 12, of $170,000,000. The air lift was discontinued after the U.S.S.R. agreed to reopen land and rail communications to the city.

**AIR LOCK,** a steel-plated chamber provided in a tunnelling shield or a caisson (*q.v.*), to prevent the escape of compressed air during the passage of workers. The pressure in the caisson may be 25 to 30 lb. per square inch, though higher pressures have been used. A steel door at each exit of the lock provides for the




THE USE OF AIR LOCKS IN CONNECTION WITH A BRIDGE CAISSON

The usual air pressure in caissons is 25 to 30 lb. per square inch, and steel locks are provided for each shaft. Excavated material is raised by power and, at great depths, cages are used to bring workers to the surface. Under the high pressure, work becomes laborious, and every effort is made to minimize the worker's fatigue

safe passage of men or material, one being opened while the other is shut. There will be several locks in a tunnel shield and in some big caissons The diagram indicates the shape of a caisson, sunk to make the foundation for a bridge pier, two shafts for material and one for men being fitted The shaft down which concrete is shot has its airlock placed lower than those of the other shafts, because the concrete mixer happens to be located on the lower platform.

Air lock also means the trapping of air in a bend; *e.g.*, of a water or gasoline supply, stopping the flow

**AIR LOG** or **AIR DISTANCE RECORDER,** an instrument which measures the distance flown by an aeroplane relative to the air. It consists of two units: a transmitter, which is installed on a wing strut or in some other position on the aircraft where it receives undisturbed air, and an indicator, which is mounted on the instrument board. The transmission may be either pneumatic or electric.

The transmitter comprises an impellor or windmill, which revolves as the aircraft moves through the air, the number of revolutions being proportional to the air distance travelled. The motion of the impellor is reduced by gearing to actuate a valve or contact at a predetermined unit of distance, the resulting impulse of air or electric current operating a ratchet in the indicator. The latter unit is simply a counter. By properly relating the pitch of the impellor blades and the gearing, the instrument will record any unit of distance, such as geographic miles, nautical miles or kilometres. The instrument is rendered inoperative below a predetermined minimum speed, in the pneumatic type by relating the air pressure to the speed in such a way that operating pressure is not available below the minimum speed, and in the electric type by using a centrifugally controlled switch. This protection is necessary to prevent the operation of the air log by the wind, while the aircraft is on the ground. (C. H. C)

**AIR MASS,** (a) in physical meteorology, the term for unit of mass of the atmosphere passed through by the sun's rays in reaching from outside the atmosphere to the earth's surface. Air mass of value 1 is defined as the amount of air passed through by the vertical rays when the sun is in the zenith Then for lesser elevations of the sun above the horizon, the air mass *m* is nearly proportional to the secant of the sun's zenith distance, and may be described as the equivalent number of atmospheres of air mass 1 which the rays would pass through at any given solar elevation.

Tables of *m* values for various zenith distances are required for convenience in calculating the absorption of solar energy by the atmosphere. In order to avoid confusion with the expression *air mass* (*see* below) as used in synoptic meteorology, E. W. Woolard and I. F. Hand suggested the word *air path* for *m*

(b) In synoptic meteorology, *air mass* is the designation for a vast body of air in which certain physical properties—mainly those of special value in analysis for weather forecasting purposes —vary but slightly in the horizontal.

The basic properties of air masses which determine characteristics of the weather are the vertical distribution of temperature and moisture content. These properties determine the actual or [illegible] of clouds and precipitation. Two air masses of similar horizontal homogeneity and similar average temperature and moisture at the ground, may have very different vertical distribution of these properties. The practice of air mass analysis for weather forecasting therefore requires upper-air soundings to determine the vertical distributions, although it is possible to infer to some extent the latter from the conditions measured at or seen from the ground.

The origin and persistence of distinctive air masses are explained by the facts: (1) that there are certain large *source regions* of the earth's surface where conditions are sufficiently uniform so that the overlying air can acquire similar characteristics; *i.e.*, horizontal homogeneity, throughout the region; and (2) that the general circulation of the world's atmosphere has large-scale [illegible] that are more or less steady and permit the travel of the air masses over long distances without being dispersed into small eddy branches.

The primary source regions are the polar areas and the subtropical belts (around 10°–30° latitude). The middle latitudes are the scene of interactions between the polar and tropical air masses, which intertwine and over- or underrun one another in great spiral trajectories that constitute the travelling cyclones and anticyclones (*q.v.*).

Such interactions produce the major weather variations in these latitudes (*see* METEOROLOGY). There is a subsidiary class of source regions in middle latitudes where the effects of the prevailing difference in temperature between ocean and continent surfaces tend to transform originally polar or tropical air masses passing over them into subtypes with distinctive and important characteristics.

Thus polar (or tropical) maritime and polar (or tropical) continental air masses are created, which also may interact in cyclones and anticyclones as a result of the large-scale air circulation bringing them together. Near the coasts very rapid and striking transformations in air mass properties often take place, when for example, warm continental air moves onto cold ocean waters (in summer) or (in winter) cold continental air moves onto warm ocean waters; although such effects do not reach to very high levels in the atmosphere and are usually limited in area, locally they may play a dominant role in the weather.

Small-scale phenomena, such as sea and land breezes, mountain and valley breezes, may be considered as the result of contrasting local or pseudo air mass source regions

Although the air mass concept was recognized in a general way by H W. Dove and others before the middle of the 19th century, its practical significance in weather forecasting was first realized in 1917 by Norwegian meteorologists hard-pressed for a new technique to compensate for their lack of foreign weather reports withheld by the neighbouring warring nations. By 1923 it had been adopted by the weather services in Belgium and Germany; by 1930 in most advanced countries. It greatly improved accuracy of forecasting, but only for periods up to 24 or 36 hr. in advance, and clarified the understanding of many familiar weather phenomena.

The classification and detailed description of air masses are found in many modern standard treatises on meteorology (*see* especially H. C. Willett, *Descriptive Meteorology* [1944], pp. 183–224).

The classifications in use, however, are all based on properties important for forecasting temperature, clouds, rain, etc It would be possible to make other classifications based on properties more important for other problems. This may not be entirely necessary, in as much as many phenomena (optical, electrical, biological, etc.) are more or less strongly influenced directly or indirectly by the same properties on which the existing forecasters' classification scheme is based.

The development of an air mass climatology has been proposed. It would entail first a description of the climate which is peculiar to each air mass type and then a description of the climates of places or regions in terms of the occurrence of the various air masses.

It had not been demonstrated by 1947 whether such a method would contribute much new understanding of the climate. In general, the usefulness of the air mass concept is limited by the lack of absolute homogeneity within and the diffuseness of the transitions between the air masses as observed in nature. The identification of air masses can not be made rigorously and only a qualitative unanimity of opinion about it can be obtained among meteorologists.

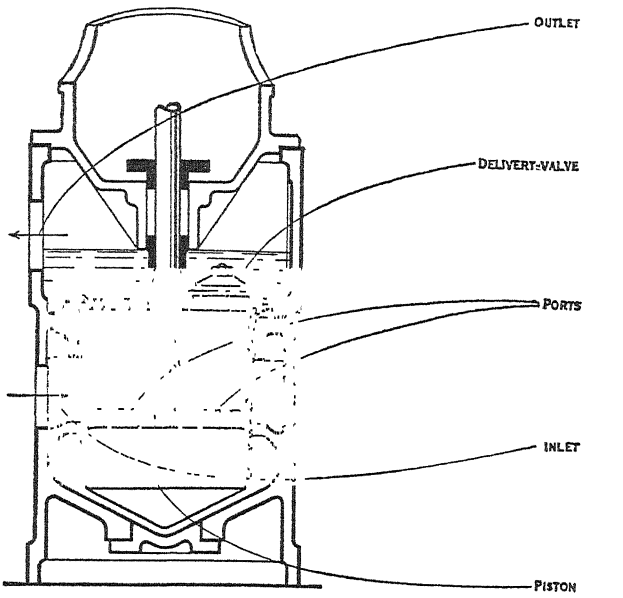
The analysis of air masses is to a large degree a matter of judgment based on a knowledge of the conservatism of the properties with time, season and region of the globe, and of the accuracy and representativity with which the properties can be measured in practice.

The occurrence of contrasting air masses with relatively sharp separations is a phenomenon mainly of the lower layers of the atmosphere, for the distinctions between the air masses readily identified near the ground are seldom traceable above 15,000 ft.

(R. G. SE.)

AIRPORT: *see* AERODROME.

**AIR PUMP.** This appliance was introduced by James Watt in 1765, when he invented the separate condenser for steam engines, in order to extract a mixture of air, water and vapour from the condenser, so providing the maximum practical vacuum. The air pump may be built as a part of the engine with its piston moved to and fro by a rocking lever, or sometimes by an extension of the engine piston rod through the back head of the cylinder A separate drive by engine or motor makes the air pump an independent unit. An arrangement of valves allows the inrush of air and vapour on the suction stroke, and expulsion through other valves on the return stroke.



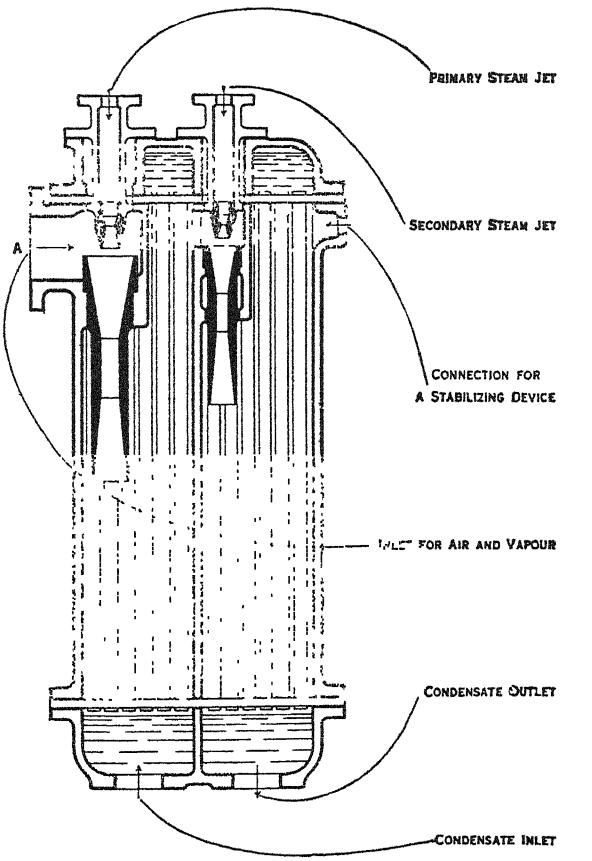

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FIG. 1.—THE WORKING PRINCIPLES OF EDWARD'S AIR PUMP

The function of the pump is to extract the water and air from a condenser. As the piston descends at high speed the water collected below it is driven with force up the curved walls and through the ports. On the rise of the piston the air is forced out through the delivery-valve with a portion of the water

A simplified pump has a conical-shaped piston or bucket (fig 1) which dashes at high speed down on to the water collected below which it drives upward into the pump barrel above the bucket, which has just uncovered the ring of ports The water, vapour and air shoot up the barrel and out through the top valve.

Modern pumps move the air independently of the water. The ejector type of air pump is the most popular A steam jet extracts the air and vapour from the condenser, which it discharges to the second jet, which finally ejects the air against atmospheric pressure. The ejector may incorporate a small condenser, an arrangement seen in the drawing (fig. 2), consisting of a series of small tubes through which water from the condenser (termed the "condensate") is pumped. The primary steam jet sucks in air in the direction of the arrow at A, and discharges it along with the operating steam into the first condensing compartment. The secondary jet withdraws the aerated vapour from the first compartment and sends it with its operating steam into the second condensing compartment. The heat remaining in the steam after it has done its work is thus transferred to the condensate, so acting as a feed-water heater to the latter on its way to the boiler. The tire pump is a familiar example of simple reciprocating class, though strictly it should be termed an air compressor. (*See* also VACUUM-PUMP.)




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FIG. 2.—DIAGRAM SHOWING OPERATION OF AN EJECTOR AIR PUMP

The type shown is operated by steam jets. The primary steam jet withdraws air and vapour from the main condenser and discharges to the secondary jet which finally ejects the aerated vapour at about atmospheric pressure. The tubes constitute a small condenser which helps to warm the condensate ready to go back into the boilers

**AIR RAIDS.** Air raids are efforts to destroy objectives on the surface of the earth by means of missiles released from aircraft in flight. They are the means of expressing the offensive in air warfare. As their name implies, they were initially looked upon as a means of harassing an enemy, and no great or decisive effect was expected from them However, as bombing aircraft became larger and more efficient, the destructive potentiality of air raids increased, until great towns were devastated, industry and transportation brought to a virtual standstill and the war-making capacity of nations fatally undermined by means of bombing from the air.

In World War I, London was the principal objective of the German air raids. On their side, the Allied air forces repeatedly attacked the industrial centres of the Rhine. The number of aircraft employed and the weight of bombs dropped in these operations were negligible by the standards of 1944–45.

In World War II, air raids worked up in a crescendo from the minor affairs of the early months of the static war (though the bomb attacks on Poland in Sept. 1939 were an indication for the future), through the relatively intense bombing of England by the Germans, to the massive Allied attacks on the axis. The end came with the V-1 and V-2 raids on England and Belgium in 1944 and 1945 and the two atomic bombs on Japan in the summer of 1945, which heralded, but were not the reason for, the Japanese surrender.

In the course of these developments, the whole technique of bombing underwent several complete transformations because of the ever increasing weight of explosive dropped from larger and larger fleets of more and more powerful aircraft, and the introduction of mechanized and radar aids to navigation, interception and bomb aiming such as had hardly been dreamed of when the war began. Finally, the perfection of the atomic bomb and its experimental use against Hiroshima and Nagasaki opened up the possibility of a new era in bombing in which not the size of the bomber fleet but the destructiveness of the individual bomb would be the determining factor in the effectiveness of the raid.

## AIR RAIDS IN WORLD WAR I

From a historical, though no longer from a military point of view, the raids on Great Britain, France and Germany in World

War I are worthy of study. In the exercise of its characteristic ability to overpass the enemy's armed forces and attack the heart of the country and its war industries, the air arm had shown that an end once and for all had been put to the possibility of limited conflicts. Henceforward, war meant total war.

**Raids in 1914–15.**—In Dec. 1914 a couple of bombs were dropped in the sea off Dover, and three days later, on Dec 24, the first German air projectile hit English soil. A few half-hearted attacks by aeroplanes during 1915 were ineffective, and it was left to the lighter-than-air machines to cause the first damage. On Jan. 19, 1915, naval Zeppelins dropped bombs on Yarmouth and Cromer and killed four people The first raid on London occurred on the night of May 31, 1915, when a single military airship caused 41 fires and 5 deaths. On June 6, Hull was bombed, with 24 fatal casualties and the destruction of 40 houses. On this night an airship, the LZ37, was destroyed near Ghent on its homeward journey by Lieut. R. A J Warneford, R.N., who received the Victoria cross for his exploit.

During the latter months of 1915, London was bombed four times. Damage amounting to £500,000 was caused, and in a raid on Woolwich 33 people were killed and 77 wounded.

**Raids in 1916.**—In the early part of the year, the British defenses had little success against the Zeppelins. On Jan 31, 1916, nine Zeppelins had their own way over the midland counties, and bombs dropped on Shrewsbury killed 59 people Of 16 British aircraft which took off to intercept, 8 crashed on landing. By the spring, however, the British defense measures improved. The L15, one of the five Zeppelins that attacked on March 31, was hit by gunfire, attacked in the air by Lieut. A. de B. Brandon of the royal flying corps and crashed into the sea off the coast of Essex. However, 15 raids on England and Scotland during April caused 84 deaths.

On Sept 2 London suffered a raid by 14 Zeppelins, of which one, the SL11, was destroyed in flames near Cuffley, Middlesex.

On Sept. 23, 1916, three of the newest super-Zeppelins attacked London. Of these, the L33 dropped 20 bombs, but the city was no longer helpless. Lit by searchlights, the airship was riddled by fire from guns and aircraft and landed near Colchester, its crew being made prisoners. A second aircraft, the L32, was brought down in flames at Billericay. Meanwhile, the third ship, piloted by Mathy, the boldest of the Zeppelin commanders, reached London and dropped a number of bombs on the outskirts and returned safely to Germany. The British casualties on this night were 40 killed.

Mathy's career was brought to an end on Oct. 1. Eleven Zeppelins crossed the coast at Lowestoft and steered toward London. Under heavy gunfire, Mathy in the L31 was brought down in flames at Potters Bar. During the whole raid by 11 aircraft, the British loss was only one killed. The defense of London had now definitely mastered the lighter-than-air attacks, and no German airship thereafter flew intentionally over the metropolis.

The first attack with airships on England in 1916 was made on [illegible] when eight Zeppelins reached the coast, one being brought down over Hartlepool and another at Yarmouth, after a remarkable flight across England to Cheshire and back to the east coast. Before the end of the year, the first aeroplane attack on London was made by a single aircraft which dropped six small bombs in daylight with slight result.

**Raids in 1917.**—By the end of 1916, the German command had come to the conclusion that it must try new methods. Early in 1917, therefore, they began to equip a squadron of aeroplanes for the systematic bombing of England.

The squadron began to operate about the end of May, but its first two attempts to reach London were unsuccessful, though in one of them a Canadian camp at Shorncliffe and a street in Folkestone were bombed causing 133 fatal casualties. One of the aircraft was hit by anti-aircraft fire and fell into the Thames. The third attempt on London was more successful. A bomber squadron attacked the city just before noon on June 13, 1917; 72 bombs were dropped in the neighbourhood of Liverpool street station, and casualties were caused amounting to 104 killed and 423 injured.

London was again successfully raided by 22 aircraft on July 7. Seventy-six bombs destroyed a number of buildings, damaged the general post office, killed 46 people and injured 123. The anti-aircraft fire was unsuccessful in hitting any of the raiders. The failure of the defense measures caused a public outcry, and the government ordered a complete reorganization The London air defenses were formed into a separate command and, under Gen. E. B. Ashmore, included all means of defense, both ground and air.

The new arrangements were soon tested. On Aug. 12, nine Gothas, heavy bombing machines, made landfall at Harwich and turned inland for London. The communication system of the defense control worked well, and the squadrons immediately defending London were at the required height in time to meet the enemy formation. The attack was beaten off, and the bombs were unloaded at Southend, where 32 people were killed.

An abortive attack by eight Zeppelins was made on the midlands on Aug. 21, and the next day the last daylight attack was made on England, when 13 Gothas started out to bomb Sheerness and Dover. British seaplanes turned them back from their objective, and three of them were destroyed by gunfire.

**Night Attacks Begin.**—The first group of night attacks by aeroplanes came in the beginning of September. On the night of Sept 3–4 hostile aircraft came in over the North Foreland and, though they did not reach London, one of them dropped a bomb on a building at Chatham where a number of naval ratings were asleep, killing 107 and wounding 86. The following night, the German squadron reached London, though a number of the aircraft were turned back by gunfire. This time damage caused was small and the total casualties amounted to only 14 killed and 48 injured.

The defenses had profited from their experience of these early night raids, the pilots in the handling of their aircraft at night and in finding their objectives, and the anti-aircraft guns in the evolution of a barrage system of fire which disconcerted the raiders.

On the night of Sept. 24, the Germans launched a double raid with an aeroplane attack on London and a simultaneous Zeppelin raid on Hull. In London, barrage fire turned back most of the raiders and brought 1 down, but 27 British aircraft which took the air failed to find the enemy. The airship raid on Hull had slight success.

During this period, barrage fire scored a considerable success in turning a large proportion of the attackers back before they had reached their target, but it was expensive in ammunition; and the defending squadrons of aircraft were still far from an efficient instrument because the central control could give no information to pilots once they had left the ground.

An airship raid on the night of Oct. 19–20 had points of special interest. Eleven airships met off the Yorkshire coast to attack industrial centres in the midlands. They flew at more than 16,000 ft., where they suffered greatly from cold and also encountered a strong northerly gale before which they drifted south helplessly. One airship crossed London and dropped a bomb on Piccadilly circus, though without realizing its whereabouts. The raid ended in disaster for the attackers. One flew back to Germany in the normal way, six got back by flying over the Netherlands or across the Allied lines, but the remaining four were destroyed on French territory.

At the end of October, the Gothas renewed their raids on London, but the defenses of the capital were showing steady improvement. Two Gothas were brought down by anti-aircraft fire on Dec. 6. In a raid on Dec. 18, the Germans first used a giant aircraft which dropped a 300 kg. bomb near Eaton square, making a large hole but doing little damage.

**Raids of 1918.**—During the first quarter of the year, five aeroplane raids took place, the Germans showing a tendency to employ more and more of the giants in place of the smaller Gothas. One Gotha was destroyed by a fighter on Jan. 28, on which night a bomb dropped by a giant aeroplane fell on a building which was being used as an air-raid shelter, and 41 people were killed. The use of the 300 kg. bomb was now becoming

general, and the damage caused by it was considerable. On March 7, the only aeroplane raid on London in a nonmoon period took place.

Meanwhile the Zeppelins began their last series of raids on England on the night of March 12. They now tended to bomb from a considerable altitude, and the damage caused was generally slight. Their last appearance was on the night of Aug 5–6, when five Zeppelins came up the coast of Norfolk. No bombs were dropped on land and the L70, the latest word in airship construction, was destroyed

In the great aircraft raid of May 19, 1918, the Germans made their maximum and final effort of the war with this form of attack. Between 30 and 40 Gothas and at least 2 giants took part. Thirteen raiders managed to reach London, and the damage was considerable; 34 people were killed and 98 injured. By this time, however, the defense was really something to reckon with The Germans lost seven aircraft: three were shot down in air combat; three were destroyed by gunfire; and one was compelled to make a forced landing because of engine failure. This defensive success was final, and the German air force made no further attempt to bomb London.

In the raids during World War I on England, the Germans employed 435 aircraft and 208 airships, which dropped 2,869 and 5,907 bombs respectively. In these raids 1,316 people were killed and 3,000 injured, and the material damage caused was considerable. Over and above this, the holdup of work in factories because of the presence of enemy raiders and the slowness of the personnel in returning to work in vulnerable areas after a raid had taken place had a far from negligible effect on production.

## AIR RAIDS IN WORLD WAR II

The possibility of raids of overwhelming severity had been impressed upon the people of Europe with great clarity during the period before the outbreak of war in 1939. The raids that had been carried out by the Italians in Ethiopia, admittedly against a primitive people entirely unprovided with defense against air attack, and the air attacks by both sides on troops and centres of population during the Spanish Civil War had made the world very bomb conscious. Moreover, most of the European countries had given much attention to measures of civil defense, in the course of which the dangers of neglect to comply with the precautions recommended had been painted in the most sombre colours. The likelihood of bombardment with poison gas had been stressed, and it was widely expected that this form of attack would be employed by a ruthless enemy from the first, as it had in fact been used by the Italian air force in Ethiopia, though not by either side in Spain.

Though most of the ideas held by the general public about air bombardment were in the highest degree fanciful and were later falsified by events, World War II began with an exhibition of air bombing which showed how important a part this form of offensive would play in modern war.

**The Continental Campaign, 1939–40.**—On the morning of Sept. 1, 1939, when the German campaign against Poland was launched, the German air force struck heavily against the Polish air force. In less than three days the air raids directed against its aerodromes caused the complete destruction of Polish air power as an effective means of resistance. Then the attacks were switched on to railway bridges, locomotives and rolling stock, to break up the lines of communication of the Polish armies. As resistance crumbled, the air raids were directed against columns of moving men and vehicles on the roads and, finally, they were centred on Warsaw, the last seat of resistance. The city suffered heavy damage.

On the western front, the first eight months of the war saw few large-scale air raids by either side. Extensive reconnaissance flights were made and data collected for the real struggle to come. In the spring of 1940 it came with great violence.

In the attack on France and the Low Countries, the German air raids were designed to assist their ground forces. In the Netherlands, parachute troops and air-borne infantry were used with striking success. Just as the Netherlands capitulated, a three-hour air raid was directed against Rotterdam. A high degree of damage resulted, and the heart of the city was wrecked

In France and Flanders, air attacks were made upon key for tresses in the great systems of French and Belgian ground defenses as well as against the French air force and railway system. The concentration of air power was so intense that the German ground forces had little difficulty in breaking through.

Under the shield of air attack the German army drove relentlessly forward to trap the British expeditionary force at Dunkirk. There the royal air force established a local fighter defense that largely nullified the strength of the German air attack, and the Germans were unable to destroy the forces being evacuated across the channel.

**The Battle of Britain.**—After the fall of France there was a comparative lull in air activity for about six weeks. Then, in August, the Germans launched a heavy air offensive against England as a preliminary to their projected invasion Though the possibility of invading the British Isles rapidly faded in face of the defensive strength of the British air forces, the bombing offensive, mainly directed against London, was sustained for many months.

Initially, the German air staff concentrated its efforts upon the elimination of the British fighter force by attacks upon aerodromes, aircraft factories and radio-location (radar) stations, while at the same time attempting to lure the fighters into the air by attacks upon shipping. Although it inflicted much damage in these attacks, the *Luftwaffe* lost heavily (76 aircraft on Aug 15), and by the end of August the first phase of the battle of Britain was over, leaving the German air staff with many lessons to digest.

During the second phase, the attacks were concentrated mainly

TABLE I—*Air Raids on Great Britain in World War II*

| Cities and towns most heavily raided | | | |
|---|---|---|---|
| Place | Tonnage of aircraft bombs dropped (metric tons) | Casualties | |
| | | Killed | Seriously injured |
| London | 12,238 05 | 29,890 | 50,507 |
| Bristol | 988 91 | 1,223 | 1,149 |
| Liverpool (and Birkenhead) | 882 88 | 3,219 | 3,073 |
| Coventry | 854 62 | 1,250 | 1,858 |
| Birmingham | 823 84 | 2,337 | 2,924 |
| Hull | 744 80 | 1,212 | 1,051 |
| Manchester | 496.42 | 577 | 583 |
| [illegible] | 489 56 | 1,169 | 1,102 |
| [illegible] | 452 47 | 598 | 889 |
| [illegible] | 342 48 | 624 | 568 |
| Glasgow | 311 72 | 776 | 597 |
| Portsmouth | 259 69 | 847 | 1,113 |
| Swansea | 243 87 | 380 | 401 |
| Belfast | 182 29 | 967 | 678 |
| Canterbury | 179 00 | 114 | 127 |
| Norwich | 154 31 | 326 | 362 |
| Bath | 132 07 | 415 | 371 |
| Cardiff | 118 08 | 263 | 353 |
| Folkestone | 103 60 | 123 | 124 |
| Exeter | 95 92 | 272 | 241 |
| Dover | 81 91 | 232 | 371 |
| York | 59 53 | 85 | 118 |
| Total for the whole of Great Britain | 70,995 00 | 60,595 | 86,182 |
| [illegible] | | | |
| [illegible] ise of Great Britain | | | 3,747½* |
| [illegible] | | | 833 |
| [illegible] | | | 24 |
| Pilotless aircraft or flying bombs (V-1) | | | |
| Target Principally London area and Manchester | | | |
| Estimated number launched (from ground) | | | 9,239 |
| (from air) | | | 1,287 |
| Number that fell in target area | | | 2,420 |
| [illegible] down by guns | | | 1,878½* |
| [illegible] down by fighter aircraft | | | 1,846½* |
| [illegible] down by balloons | | | 231½* |
| Total brought down by all arms | | | 3,957 |
| Casualties | | | |
| Killed | | | 6,184 |
| Severely injured | | | 17,981 |
| Slightly injured | | | 24,493 |
| Rockets (V-2) | | | |
| Target Principally London area and Norwich | | | |
| [illegible] launched | | | not known |
| Number reported by the defenses | | | 1,115 |
| Number that fell in London area | | | 518 |
| Casualties | | | |
| Killed | | | 2,754 |
| Severely injured | | | 6,523 |
| Slightly injured | | | 15,438 |

*Fractions relate to claims shared between different arms of the defense
Source Compiled from data given by the Home Office and by the Air Ministry, London.

upon London and were made both by day and by night. With the exception of the attack of Sept. 7, 1940, with about 400 aircraft, the *Luftwaffe* was unable to break through to the heart of London by day, and though the casualties and damage inflicted on that occasion were heavy, its own casualties during these weeks, which reached a figure of more than 50 on some days, convinced it that daylight raids in face of the defenses of the metropolis did not pay. A week later, in the course of raids on the outskirts of London and the south coast, the German air force suffered heavily, losing 56 aircraft in one day.

In the final, long drawn out phase of the battle, heavy and sustained night attacks were made against London and other British cities, but there was little real military purpose behind them. Almost nightly for three months, up to the end of 1940, German bomber attacks averaged 200 sorties a night The casualties they inflicted during this period were heavy, but they failed to break the spirit of the people or vitally to damage industry. The general accuracy of the bombing was poor, with a high proportion of bombs falling in open country or on unremunerative targets Later, although attacks continued to be made for a time and damage resulted to London and a number of other towns of industrial or cultural importance, the German bombing policy lost its objectivity, and with the *Luftwaffe's* preoccupation elsewhere and the greater strength of the British defenses, heavy aircraft raiding of England virtually came to an end by the early summer of 1941.

**Malta and the Mediterranean.**—The Germans next switched their attention to the Mediterranean, where their Italian allies were in need of support in their African campaign. It was first necessary to eliminate Malta as a platform for British aircraft capable of harassing the sea routes; and therefore 1941 and early 1942 saw a heavy air offensive carried out against the island. The German bomber force consisted of about 150 Junkers 87s and 88s, protected by Italian fighters, and Malta, with the slenderest of fighter defenses, suffered heavily, not only from attacks on the island itself, but through the losses incurred by convoys attempting to bring in fuel, food and reinforcements. The bomb attacks on Malta, however, always just failed to be sufficiently sustained to achieve their object, and the need to divide the *Luftwaffe* to deal with the needs of the desert campaign in Africa and of the successive attacks upon the Balkan countries and Russia meant that the bomber forces were too weak to deal a knockout blow anywhere. During 18 months fighting in the Mediterranean, the Germans were generally trying to do too many things at the same time, with the result that they were weak and comparatively ineffective everywhere. By June 1942 their Mediterranean air offensive was over, and thereafter the initiative swung to the side of the Allies. British bombers cooperated with ground forces in beating Field Marshal Erwin Rommel's armies in Africa; they helped the Allied forces to sweep forward to Italy; captured aerodromes gave the bombers [illegible] operate over the Alps into southern Germany; and the main Allied bombing policy now began to exhibit the rudiments of the plan that led on to an unbroken succession of attacks of increasing intensity and the staggering blows that were to paralyze German and Japanese resistance three years later.

**The *Luftwaffe* in the Russian Campaign.**—In the U.S.S.R., the *Luftwaffe* commanders proved that they had really learned [illegible] experience which they had by now received in the handling of air forces in modern war. For them, air power was [illegible] to be used for the tactical benefit of the armies in the prosecution of the blitzkrieg, the one form of warfare upon which the German high command relied for the achievement of victory For this reason, there is little to be learned by the student of war from a consideration of the bomber operations which took place on either side during the Russian campaign. The heavy bomber raids on Moscow and other soviet cities were for the most part badly planned affairs in which heavy losses were [illegible] fighters and anti-aircraft defenses, whereas relatively [illegible] damage was done to the objectives. On the soviet side, bombing took rather a haphazard form and had little effect upon the progress of operations.

**The Strategic Plan.**—Despite the failure of the Germans to achieve their objective in the battle of Britain, there were those on the Allied side who were unshaken in their belief that a bomber offensive properly directed, unfalteringly sustained and of sufficient weight would prove decisive in the winning of the war. The errors made by Germany in directing air offensives against the British Isles, in the Mediterranean and in the course of the Russian campaign were evident, and by 1942 the inability of the *Luftwaffe* to play a decisive role was obvious. Since the beginning of the Russian campaign, the *Luftwaffe* had been fighting on three fronts at once, and already the German aircraft industry was swinging away from the construction of strategic bombers to concentrate on tactically offensive or purely defensive types. The British royal air force early initiated a policy of night attack upon German industry and had continued these attacks to the limit of its strength in unbroken and increasing intensity.

Soon after the entry of the U.S. into the war, U.S. bombers began to arrive in Great Britain to take their part in this offensive. Within six months more than 400 heavy bombers were based on British aerodromes, and on Aug. 17, 1942, 12 Flying Fortresses made a day attack on the railway marshalling yards at Rouen, France, and returned without loss. The day and night partnership of the U S. and British bomber forces had begun.

In Jan. 1943 the Allied leaders at Casablanca authorized an increased bomber offensive and defined its object as "the destruction and dislocation of the German military, industrial and economic system and the undermining of the morale of the German people to the point where their capactiy for armed resistance is fatally weakened." It was clear that the ability of the bomber forces to implement this directive largely depended on the possibility of checking the activities of the German defensive fighter forces. A first call upon the activities of the bombers was, therefore, to destroy the factories where the fighter aircraft were constructed, together with the engine, ball-bearing and accessory plants associated with them Once a sufficient degree of immunity from interference had been won for the bombers, they could turn their destructive activities to other and more direct sources of the enemy's power of resistance.

The new offensive began forthwith and, despite heavy losses to both the Allied air forces, considerable results were achieved: the rate of delivery of fighter aircraft to German air force units was sensibly reduced. Though the effect of this slowing up of production was not felt immediately, the shortages that were ultimately imposed on the fighter units had a significant effect upon their ability to interfere with the Allied attack at a most critical stage of the war early in 1944.

Although right up to the end of World War II Germany continued to concentrate the main portion of its aircraft productive capacity on the output of fighter aircraft to defend its cities and industries against the increasing weight of bomber attack and though the Allied bombers continued to suffer severely from German fighter attack, sufficient freedom of action was won for them to attack with increasing force every phase of German life and war-waging activity and especially its cities, transportation systems, fuel and heavy industries. The Allied air staffs devoted much energy and ingenuity to the collection and interpretation of information concerning German industry and in assessing its vulnerability to raids and the speed at which it would recover from such attacks. As time went on, valuable information was accumulated and many earlier estimates of the effect of bombing upon industrial targets had to be reconsidered. For instance, intelligence sources indicated, and postwar investigation afterward confirmed, that even the most destructive raids often had a much smaller effect than was expected upon the productive potential of a plant. Generally speaking, it may be said that the most rewarding strategic targets were oil and nitrogen plants and attacks upon transportation targets. Later, when the royal air force turned to area bombing of towns, one of the most important effects upon the enemy war-making capacity was the number of workers who had to be diverted from productive work to such activities as debris clearance, reconstruction and the

replacement of household goods destroyed in raids. It was estimated that by the end of 1944, 20% of the German labour force, excluding agricultural workers, was engaged in this type of work.

**Invasion of the European Citadel.**—In the preparation for the invasion of the German fortress of Europe, the air had a many-sided offensive role to play. In the long period of preparation, when attacks upon the centres of production and the means of transportation were most important in order to prevent the enemy from reinforcing and supplying his defensive forces, the ability of the bombing forces to make deep penetrations into Germany depended largely upon their freedom from interference. During the early part of 1944, therefore, the long-range fighters which could accompany the bombers to their objectives—notably the U S. P-51 Mustang fighter—had a vitally important part to play. By tempting the German fighters, whose production was already suffering from the offensive against the aircraft factories, into the air and destroying them there, the Mustangs not only enabled their bombers to attack their objectives with success but also ensured that, when the invasion came, the ground forces could proceed from the United Kingdom virtually immune from attack from the German air force.

In the invasion itself, the air forces played manifold roles in conjunction with the surface forces. Saturation bombing (as at St Lô, where 2,500 bombers operated against an area 3,000 yd. by 7,000 yd. for two-and-one-half hours on end) was used to facilitate local attacks. Raids upon bridges, railway and road junctions, supply dumps and communications centres were practically continuous as called for by the land commanders to soften enemy resistance and enable the program of advance to be maintained: and, as a background to all these tactical interventions, the steady bombing of fuel and manufacturing targets went on in order to starve the enemy of the means to move and fight. Against these activities the enemy air forces were able to do little, since the great preinvasion offensives had had the effect of draining them of their lifeblood.

**The Pilotless Aircraft and Rocket Campaign.**—For more than a year before and during much of the invasion period, a considerable proportion of the Allied bomber force had had to be diverted from an offensive to what was, in reality, a defensive role. The preparations which the Germans were making to open a heavy attack with pilotless aircraft and rockets against England became known to the Allies in 1943, and from then on heavy and frequent attacks were made upon the factories where these weapons were being produced and upon the hydrogen and liquid oxygen plants that produced their characteristic fuels. Moreover, as soon as the construction of launching sites on the northern coasts of the continent opposite southern England was observed, these sites were subjected to a high intensity of attack. The beginning of the actual attack by the V-1 pilotless aircraft on England was practically simultaneous with that of the invasion of Normandy, and it is clear that, had the launching sites and manufacturing centres not been attacked as they were, the V-1 offensive would have begun earlier and in greater intensity and might have seriously interfered with the invasion preparations. As it was, more than 8,000 V-1's were launched against England and nearly 8,000 against continental targets, chiefly Antwerp, after the Allied forces were in occupation of the continental channel coast. The rocket attacks came mainly from the Netherlands and western Germany; a total of 1,100 exploded in England and 1,675 on the continent, again chiefly on Antwerp, which was in use as an Allied invasion port. London was the usual objective of the attacks upon England, though inevitably the southern counties on the route of the V-1s and V-2s to London were sprinkled with those that fell short or were intercepted and shot down on the way. In the course of countermeasures against these missiles, a campaign which lasted for 13 months in all, a total of 100,000 tons of bombs was dropped, representing 9% of the total tonnage dropped by the Allied air forces from the United Kingdom during the period. Quite apart from the damage actually caused by the weapons themselves, the threat which they represented had thus a considerable value for the Germans in diverting Allied bomb tonnage away from industrial targets and centres of population.

**Statistics of Air Raids in the European Theatre.**—During the course of the war in Europe, the Allied air forces flew nearly 1,500,000 bomber sorties from the United Kingdom against the axis. In these, nearly 2,750,000 tons of bombs were dropped, with a loss of more than 20,000 bomber aircraft and nearly 160,000 men, divided almost equally between the U.S. and British air forces.

TABLE II—*Allied Bomb Tonnage Dropped at Principal European Target Systems of the Axis Powers, 1939-45*

| Type of target | Tonnage dropped (to nearest 1,000 tons) | Percentage of total |
|---|---|---|
| Aircraft factories | 48,000 | 1.8 |
| Miscellaneous manufactures | 70,000 | 2.6 |
| Water transport | 113,000 | 4.2 |
| [illegible] | 54,000 | 2.0 |
| [illegible] | 186,000 | 6.9 |
| Oil, chemicals, rubber | 251,000 | 9.3 |
| Military targets | 300,000 | 11.1 |
| Industrial areas | 640,000 | 23.7 |
| Land transports | 867,000 | 32.1 |
| All other targets | 170,000 | 6.3 |

Table II gives the distribution by percentages of the bomb tonnage dropped on Germany and countries in association with or occupied by it; while German statistics show that, as an incidental concomitant to the Allied raids, more than 3,500,000 dwelling houses or flats, about 20% of the total, in Germany were destroyed or heavily damaged; 250,000 civilians were killed and more than 300,000 seriously wounded. A comparison of these figures with those for casualties in the raids on England in World War I offers a grim commentary on the progress of air bombing between 1914 and 1945.

**The Pacific Area.**—On Dec. 7, 1941, Japan opened its campaign against the U.S. in the Pacific with a temporarily overwhelming display of air power, employed without warning at a time of international tension but when the two countries were still officially at peace. For negligible losses, the Japanese air force at Pearl Harbor practically eliminated U.S. naval power in the Pacific for the time being. On Dec. 10 the sinking of two major British naval units off Malaya for the loss of only four medium bombers lent further point to the lesson that naval forces were an easy prey to air attack unless provided with air cover. Within a few months, under an air umbrella and helped forward by air bombing against weak ground forces, the Japanese had overrun Malaya, the Philippines and Burma, as well as having gained control of vast areas of the Pacific, all at very minor expense in men and equipment.

On the Allied side, the really significant air event of this period was an air raid led by Gen. James Doolittle on Tokyo on April 18, 1942. Though the material damage caused was slight, the proof of vulnerability to attack in the heart of its empire which this raid gave to the governing junto in Tokyo persuaded it to expand its perimeter beyond the limits which it could possibly defend and supply and thus sowed the seeds of its ultimate collapse. Thus, though Gen. Doolittle's exploit was looked upon at the time rather as a superb gesture of defiance than as a serious contribution to the winning of the war, a retrospective view puts it into a very different perspective.

For the next two years, the main air problem for both sides was to bring aircraft within range of the enemy. Over the great distances of the Pacific, it was possible often to strike at the enemy only with carrier-based forces. The target was sometimes the enemy fleet, sometimes the garrisons and installations on islands on the perimeter of the Japanese sphere of domination. At all times, Japanese merchant shipping, vital to the supply of their armies, received a full measure of attention from the U.S. bombers. Within a year of Pearl Harbor, 4% of the whole of the Japanese merchant fleet had been sunk by aircraft action alone, and it continued to be a high priority target until the end, by which time, of a total of 9,000,000 tons sunk, nearly 3,000,000 tons had been destroyed by air attack. At the same time, concentrated bombing of the Japanese navy took a heavy toll. Of a total of 2,250,000 tons of warships possessed by Japan, nearly 700,000 tons were sunk by air attack in the course of World War II.

In areas where it was possible for air forces to operate from land bases against Japanese-held outposts, it was necessary to provide such bases at short notice and to strike from the air against the long lines of communication, whether by sea to the Pacific islands or by land as in Indo-China and Burma. While, on the ground, the Japanese were largely on the defensive, their air forces often struck back hard and it was not until early 1943 that the initiative in the Pacific had definitely passed to the Allies.

But, just as in Europe the main objective of the air raids of both sides was the heart of the enemy's home territory, so in the Pacific war, the U S looked to the attack on Japan's industry and home population as an essential feature of its defeat. The U.S. was fortunate in that at no period of the war was it in serious danger of air raiding of its home country by the Japanese bomber force, except for the possibility of tip-and-run raids from carrier-based forces against the Pacific coast, which in fact never took place. The nearest the enemy got to bomb attacks on the United States homeland was the random release of some explosive-loaded balloons, designed to fall in the western states The nuisance value of this primitive form of attack was, however, slight.

To attack the Japanese home islands, air bases had to be secured within 1,500 mi. of them to enable the long-range bombers to operate This dictated a large-scale advance from the perimeter, on the south to the Philippines; in the central Pacific to the Marianas and on to Okinawa. In the course of these preparatory operations, air power was exploited to the utmost, air forces being used from carriers and from specially constructed air bases within range to smother enemy resistance and neutralize air forces. To hold this air offensive in check, the Japanese committed all their available aircraft and suffered losses which they were never afterward able to make good, although production of aircraft had increased greatly, reaching more than 2,000 a month in 1944. In spite of losses in aeroplanes amounting to 9,000 in the Philippines campaign, the output from Japanese factories should have been sufficient to maintain first-line strength had air crew training and ground services matched production; but in these particulars, the Japanese air staff failed seriously, and the air force fell lower and lower in the scale of efficiency.

**Suicide Bombers.**—It was the recognition of their inability to equal the Allied air forces in efficiency that led the Japanese commanders to exploit the willingness of their pilots to engage in suicide attacks, the so-called Kamikaze technique in which the pilot deliberately crashed his explosive-laden aircraft into his objective In all the Japanese flew 2,500 suicide sorties, of which 475 secured hits, sinking 45 ships and doing serious damage, [illegible] battleships and 16 aircraft carriers. In [illegible] direct effect the U.S. air force was constrained to divert 2,000 heavy bomber sorties from industrial targets to Kamikaze bases.

**Attacks upon the Japanese Homeland.**—A chain of islands with relatively small quantities of basic raw materials available [illegible] the Japanese empire was ill equipped to fight a major [illegible] power in the absence of adequate supplies from overseas. [illegible] the Asiatic mainland in the years before [illegible] Japan remained almost completely dependent upon its sea communications for its war-making capacity By the virtual destruction of its merchant fleet, it was reduced to such a condition by 1944 that its ultimate defeat by exhaustion of supplies was inevitable. Nevertheless, the Allied strategy contemplated an invasion of Japan, for which a bombing offensive against its industries and cities was a normal preliminary

The offensive opened from the Marianas in Nov. 1944. At first the targets selected were mainly air frame and aero-engine factories; but in March 1945 a decision was taken to act directly against Japanese centres of population, with the object of destroying the will to continue the struggle.

[illegible] period of ten days, more than 9,000 tons of bombs were dropped, causing the total destruction of 31 sq mi. in the four towns of Tokyo, Nagoya, Osaka and Kobe. Thereafter, bombing attacks alternated against towns, factories, oil refineries and airfields. In all, 160,000 tons of bombs were dropped against Japan itself, as against nearly 1,500,000 tons dropped on Germany. Nevertheless, the physical destruction in Germany and Japan resulting from air raids was comparable. The attack on Japan was more concentrated in time, and the target areas were more vulnerable. Forty-four per cent of the built-up area of 66 cities was destroyed and 30% of the urban population of the whole country lost their homes After five months of bombing, the Japanese economy was very close to the breaking point, even without other factors.

**The Atomic Bombs.**—Early in Aug. 1945, the first two atomic bombs ever used in war were dropped by a U S aircraft on Hiroshima and Nagasaki respectively. In the two attacks, 100,000 people were killed and six square miles of built-up area completely devastated. It was calculated that the damage caused by these two bombs was equal to that which would have been done by 345 B-29 bombers carrying more than 3,000 tons of conventional bombs.

Though, indeed, the Japanese government had been casting about since early May to find a way to end the war, the effect caused by the explosion of the two atomic bombs and the fear of similar attacks was used by them as a reason for an immediate surrender.

**Conclusion.**—In the course of two world-wide conflicts within the space of 40 yr., the technique and potentiality of raiding from the air had progressed from the dropping of a 20 lb. bomb from a single aircraft to the unloading of millions of tons of explosive and two atomic bombs by many thousands of aircraft. The effect of air bombing had, in the same period, passed from being a mere irritant to playing a main role in deciding the issue of wars.

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(D. CR.)

**AIRSCREW**, the designation of all those devices which, when rotated, [illegible] screw their way forward, sucking the air from in front and throwing it away behind, or which, when placed in a moving stream of air, are themselves rotated. The term covers: (1) fans of a certain type; (2) screw propellers working in air; (3) helicopters; (4) windmills; (5) gyroplanes.

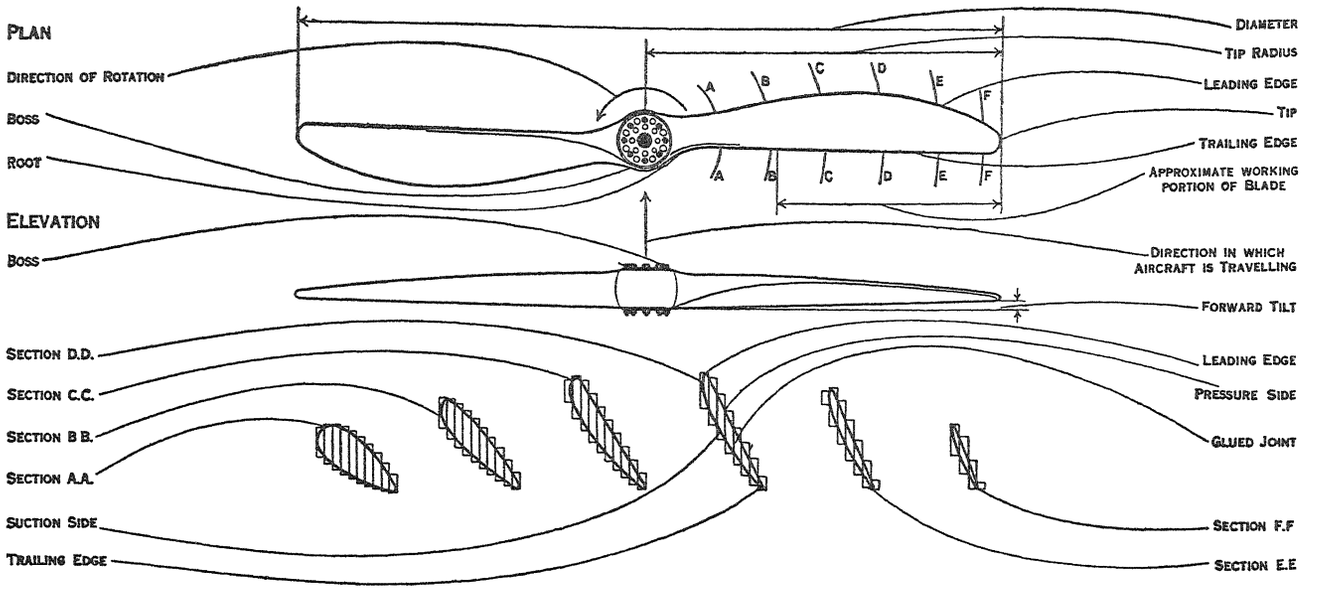
(1) If the airscrew is rotated but restrained from forward movement, air is drawn in from the front and thrown back behind, and the airscrew acts purely as a fan.

(2) If the airscrew is not so restrained, the thrust caused by moving the air backward drives forward the airscrew and the aircraft, or body, to which it is attached. The airscrew is then acting as a propeller. The thrust exerted, and the volume of air moved, have their maximum value when the airscrew is acting purely as a fan. As the airscrew moves forward, the volume of air delivered and the thrust exerted decrease, and at a certain speed become nothing At this forward speed the distance moved in one complete revolution is known as the experimental pitch of the airscrew. The thrust acts approximately in a horizontal direction.

(3) If, however, the airscrew is placed so that it exerts its thrust upward in an approximately vertical direction, it is then acting as a helicopter.

(4) In the above conditions the airscrew is driven by some engine or motor, but if it is placed freely on a shaft in a wind, or if it is moved forward through the air, it will rotate and some of the energy in the moving air will be transformed into useful work and transmitted to whatever mechanism is attached to the airscrew. The airscrew is then acting as a windmill. The wind blows approximately in the direction of the airscrew shaft; *i.e.*, at right angles to the plane of rotation.

(5) If the wind blows at a small angle to the plane of rotation, the airscrew will not only be caused to rotate, but in doing so will exert a thrust. It is then acting as a gyroplane. The best known




FROM WATTS, "SCREW PROPELLERS FOR AIRCRAFT" BY PERMISSION OF LONGMANS GREEN & CO., LTD.

FIG. 1.—PLAN, ELEVATION AND CROSS SECTIONS OF A TWO-BLADED PROPELLER. THE CROSS SECTIONS IN LOWER HALF OF ILLUSTRATION WERE MADE AT THE POINTS A, B, C, D, E, F, ON THE TOP FIGURE, THEY SHOW THE TWISTED SHAPE OF THE AIRSCREW BLADE

example of this use of the airscrew is the autogiro, invented in Spain by Don Juan de la Cierva. In this case the plane of rotation is approximately horizontal and the thrust approximately vertical.

**General Description.**—An airscrew consists of a boss or hub with spokes radiating therefrom—like a wheel without a rim. The number of spokes or blades, as they are technically termed, is usually two or three, though four are sometimes used, particularly on the larger British transport craft. They have seen little use in the United States, however.

In fig. 1 is shown the plan and elevation of a two-bladed airscrew intended for use as an aircraft propeller. Below them are shown the sections which would appear if the blade were cut through at points A, B, C, etc. The terms used in connection with airscrews are also shown. Note the term "diameter," the distance from the tip of one to the tip of the opposite blade. For aircraft propellers the diameter varies from as little as 4 ft. to as much as 19 ft. Note also the characteristic shape of the cross sections of the blade. Sections of this shape are called aerofoil sections; their properties will be found described in any standard work on aerodynamics. The shape of these cross sections has an important influence on the efficiency of the airscrew. It will be noticed that the blades are twisted; the angle is greater at the root than at the tip. This twist is necessitated by the fact that in order to work most efficiently, an aerofoil section must move at a small angle to the relative air flow.

Now any point in the blade has two simple motions: (1) in the direction of rotation; (2) the forward motion at right angles to (1) In fig. 2 these two simple motions are illustrated to scale as AB and AC for a point near the tip of the blade, and in fig. 3 for a point near the root of the blade; AD is the resultant direction and speed of movement. The speed AC of the forward movement is the same for both points, but the speed AB in the direction of rotation is proportional to the distance of the point from the centre. Its value is zero at the centre and a maximum at the tip.

Thus as will be seen from figs. 2 and 3, the resultant direction of movement of the point near the tip is at a smaller angle to the plane of rotation than that of the point near the centre. Since the aerofoil section must be placed at a small angle to its direction of movement, the blade has a smaller angle at the tip than near the centre. The distance travelled in one complete revolution, when the direction of the resultant motion is along the line joining the leading and trailing edge of the section (*see* fig. 1, section D.D.), is the geometrical pitch. It has approximately the same value for all parts of the blade and is usually referred to by the word "pitch."

**Problems of Design.**—The main difference between various airscrews is in the diameter and pitch, and it is the designer's object to choose these for the attainment of certain specified results. He has three aims: (1) To ensure that the airscrew runs at a certain rate of rotation when driven by a certain power, when the aircraft to which it is attached is travelling at a certain speed at a certain height above sea level. (2) To ensure that under these conditions the airscrew will give its maximum efficiency (The efficiency is the ratio of the useful work done by the airscrew to the work done by the engine in turning it. Efficiencies of from 75 to 87% are commonly attained.). (3) To ensure that the airscrew is reliable and safe Airscrews rotate at a high speed. Their tips travel at speeds varying from 700 to as much as 1,100 ft per second—a velocity exceeding that of sound. This sets up a centrifugal pull in the blade of as much as from 10 to 25 tons, in addition to which the blade must withstand the bending caused by its own thrust.

To satisfy these various requirements, the designer will specify an airscrew of a certain diameter and pitch, with blades of a certain width and thickness. If any one of these conditions alters—the rate of rotation, the power or the aircraft speed—a different airscrew will be required. Hence the infinite number of designs involved.

**Controllable Pitch Airscrews.**—From the very start of aircraft development it has been plain to engineers and inventors that it would be very desirable to alter the pitch angles of the propeller blades during flight. If the blades are set at the proper angle for level flight at relatively high forward speed, the angles are too high at the time of take-off and climb when the forward speed of the aeroplane is low, so that the propeller is operating inefficiently under these conditions. When the internal-combustion engine was adopted universally as an aircraft power plant, there was an additional need for a variable or controllable pitch airscrew, since a propeller which was set for the proper engine rotation at level flight would not allow the engine to turn at its full rated speed at the time of take-off, so that there was a material loss in engine power under these conditions. The effect of the controllable pitch propeller on the engine is analogous to that of the gear shift for the automobile, and the controllable pitch propeller has sometimes been referred to as the "gear shift of the air."

A large part of the early pioneering development on the controllable pitch propeller was carried out at the aeronautical

laboratory of the U.S. army at McCook Field, Dayton, O. These experiments led to the adoption of the detachable aluminum alloy blades for the propellers. While the pitch of these early propellers could not be changed in flight, the development of the aluminum alloy blade paved the way to a large degree for the later development of the controllable pitch propeller

A large number of types of controllable pitch propellers were built experimentally The Hamilton standard is one of the leading successful controllable pitch propellers, and may be taken to indicate the development of this adjunct to flying The original of this type was built in late 1929, and improvement was rapid after that time During 1933, the Hamilton standard came into universal use on the air transport lines of the United States, and the propeller was awarded the Collier trophy for the greatest advancement in aviation during that year.

This propeller is made with semihollow aluminum alloy blades journaled at the end on plain bearings. Centrifugal load on the blades is taken up by means of roller bearings encircling the inner ends of the blades. The actual operation of changing the pitch is carried out by means of an oil cylinder which forces the blades into the low pitch position when oil pressure is applied When the oil pressure is released, the propeller is forced into high pitch by means of counterweights which are acted on by centrifugal force.

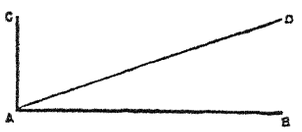



FIG. 2

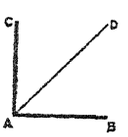



FIG. 3

FIGS. 2 AND 3.—DIAGRAM SHOWING THE MOVEMENT OF A POINT NEAR THE TIP OF THE BLADE AND NEAR THE BOSS OF THE AIRSCREW

AB = Velocity of rotation. AC = Velocity of forward motion. AD = Resultant velocity

The device is very simple in design and in operation. In the initial form, it utilized two pitch settings, one being suitable for take-off and climb, and the other for level flight and cruising. The latest development of the device incorporates an automatic governor which serves to change the pitch automatically so as to maintain the engine operation at any constant number of revolutions per minute which may be selected by the pilot in flight. This device is known as the constant speed propeller.

**Materials of Construction.**—At first airscrews were invariably constructed of hardwoods, such as walnut or mahogany. The blades were built up of a number of superimposed planks or laminae about one inch thick, suitably cut to shape. In fig. 1 the cut planks for a two-bladed airscrew are illustrated. The planks are glued together to form the rough block from which the airscrew is shaped. This and the finished airscrew are also shown.

Wooden airscrews are affected by the humidity and temperature of the atmosphere, and have been found unsuitable for tropical climates. Hence there has arisen a need for metal airscrews. Of such there are two distinct types: airscrews with hollow blades, and those with solid blades. The former are constructed of steel and the latter of a light metal, usually an aluminum or magnesium alloy. Both types have met with a considerable degree of success, but both are heavier and more costly than the wooden airscrew. Despite the added expense, however, metal propellers have come into very common use, particularly on engines of higher horsepower In large sizes the weight of the solid type appears likely to be excessive, while that of the hollow steel type approaches very closely to that of a wooden airscrew.

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**AIRSHIP,** a self-propelled dirigible aircraft, inflated with a gas lighter than air and sustained aloft chiefly by buoyancy from aerostatic forces. To distinguish it from the free balloon or balloon which has similar lighter-than-air flight characteristics but no propelling or steering system, the airship is sometimes popularly referred to as a dirigible balloon or dirigible.

Consisting of an elongated gas-filled streamlined hull, mounting one or more cars or gondolas, power plants and stabilizing fins with attached rudder and elevator control surfaces, airships are classified according to three structural types: nonrigid, semirigid and rigid.

The hull of a nonrigid airship, the so-called blimp type, consists of a gas-tight fabric envelope which maintains its form by the pressure of the lifting gas and air ballonets (which inflate and deflate to compensate for changes in gas volume) contained therein. The semirigid airship similarly depends upon internal gas and air pressure to sustain the form of its envelope but has in addition a supporting metal keel extending longitudinally along the bottom of the ship. Because of their reliance upon a pressure differential for the maintenance of envelope rigidity, nonrigids and semirigids are also known as pressure airships This distinguishes them from the rigid airship, the hull of which, consisting of a rigid structural frame, maintains its shape irrespective of internal gas pressure. Around this framework of girders, an outer cloth covering is secured, and, inside, individual gas cells are arranged throughout the ship's length.

## EVOLUTION OF THE AIRSHIP

Human flight was first made possible in 1783 by the invention of the free balloon, and there immediately followed a period of intensive balloon development (see BALLOON). The airship was the inevitable result of [illegible] and of man's desire to construct an aircraft which could be propelled and steered. Accordingly, from 1783 to 1852, when the first airship was flown, numerous unsuccessful attempts were made to propel and steer balloons. These efforts failed primarily because of lack of a suitable mechanical means of propulsion and the consequent dependence upon oars and other primitive types of manual power.

Finally in 1851, Henri Giffard, the French inventor of the steam injector, overcame the airship power plant problem by developing a 350 lb. steam engine of 3 h.p. which could drive a propeller 11 ft. in diameter at 110 r.p.m. The following year, he constructed an 88,000 cu.ft. airship, 144 ft. long and 40 ft. in diameter, and mounted his engine thereon. Giffard ascended in this hydrogen-filled craft on Sept. 24, 1852, from the Hippodrome in Paris and, at an estimated speed of 6 m.p.h., demonstrated in a light wind the first appreciable control ever exerted on a lighter-than-air craft.

Initial application of the internal-combustion engine to airship flight was made by the German engineer, Paul Haenlein, when in 1872 he completed and flew an airship propelled by a gas engine drawing its fuel from the envelope. The French brothers Albert and Gaston Tissandier were the first to build an electrically powered airship; their 37,500 cu.ft. craft, powered by a

1.5 h.p. electric motor, made a successful initial flight on Oct. 8, 1883.

The first airship to possess sufficient control enabling it to return to the point of ascent was the electrically powered 66,000 cu.ft. "La France," constructed of an envelope of Chinese silk and a car of bamboo trelliswork. Powered by an 8 h.p. electric motor and piloted by its constructors, Charles Renard and A. C. Krebs, this French airship made its first trial on Aug. 9, 1884, at Chalais-Meudon and completed a circular flight of about five miles. By this and subsequent similarly successful flights, the "La France" demonstrated to the world the practicability of airship navigation.

The 130,000 cu.ft. David Schwarz aluminum-hulled airship, built and tested in Germany in 1897, was the first airship of the rigid type. Consisting of an aluminum framework covered by aluminum sheeting, it was also the first airship powered by a gasoline engine. Although the craft failed on its initial flight because of gas leakage and faulty power transmission, it was noteworthy for having introduced the rigid and metal-clad principles to airship construction.

Meanwhile, Albert Santos-Dumont, a Brazilian living in Paris, had become interested in lighter-than-air flight, and in 1898 completed his first in a series of 14 nonrigid, gasoline-powered airships. These small Santos-Dumont ships performed a number of record-making and unusual flights which won world-wide fame for their constructor. In 1905, Santos-Dumont abandoned airship development to turn his inventive genius to heavier-than-air craft.

An event of great importance was the construction of the first Zeppelin airship (LZ-1) which made its initial flight from a floating hangar on Lake Constance, Germany, on July 2, 1900. Designed by Count Ferdinand von Zeppelin, a German army officer who had retired to devote his full-time efforts to the development of a radically different airship of rigid structural design, the 388,410 cu.ft. LZ-1 was 420 ft. long and 38 ft. in diameter. Its cigar-shaped aluminum frame consisted of 24 longitudinal girders extending from nose to tail, spaced by 16 transverse rings, and braced by diagonal wiring. The entire frame was covered by a cotton cloth to protect the inner structure and to present a smooth outer surface. Inside the framework, between the transverse rings, were separate hydrogen-filled gas cells of rubberized cloth, while, under the craft, was a keel-like structure connecting two external cars. In each of the cars was a 16 h.p. engine geared to two propellers. A sliding weight secured to the keel was designed to afford vertical control by raising or lowering the nose; rudders were provided for horizontal control. Despite structural weaknesses, the LZ-1 proved the practicability of the Zeppelin design and attained speeds approaching 20 m.p.h. In constructing subsequent airships, Zeppelin experienced numerous financial reverses and accidents which threatened to end his aeronautical activities; popular subscription and later governmental support, however, enabled the development of the Zeppelin airship to continue uninterruptedly until the end of World War I.

During the first decade of the 20th century, airship construction was carried on in most of the major countries of the world. Such development was at first generally limited to private enterprise and to the efforts of aeronautical sportsmen and inventors. However, as these pioneering efforts began to meet with success, governmental interest arose, and the employment of the airship as a war machine soon followed.

During World War I, airships saw considerable use by the major belligerents. Germany's Zeppelins, developed by that time to a point of great strength, large load carrying ability and high performance characteristics, operated with the Imperial German army and navy. Military and naval missions were flown by French pressure airships, while similar war duties were performed by Italian semirigids. Great Britain and the U.S. looked to their nonrigids for a solution to the U-boat problem. Given the impetus of war, the airship underwent unprecedented development from 1914 to 1918. Zeppelins were produced at the rate of one every two weeks; nonrigids were built which could make routine flights of 30 hr. and more; all phases of airship construction, operation, maintenance and ground handling were improved.

The treaty of Versailles prohibited the Zeppelin company from undertaking further airship construction and directed the delivery of existing Zeppelins and hangars to the victorious Allied powers. With these Zeppelins and with other rigid airships of their own design and construction, France, Great Britain and the U.S. undertook rigid airship programs which during the 1920s and early 1930s constituted an important part of their national aeronautical activity. The loss, however, of France's "Dixmude" (1923), Britain's R-101 (1930) and the United States' "Macon" (1935) led to the abandonment of rigid construction and operation by these countries. French and U.S. airship activity was thereafter limited to the operation on a reduced scale of small nonrigids or semirigids, while Great Britain terminated its airship program in its entirety. The abandonment of rigid airships by these three nations left Germany, whose Zeppelin company had re-entered the airship field by constructing the U.S. navy's reparations dirigible "Los Angeles" (1924) and the commercial ships "Graf Zeppelin" (1928) and "Hindenburg" (1936), as the sole constructor and operator of the rigid type of craft.

The period immediately preceding World War II witnessed the destruction by hydrogen fire in 1937 of the Zeppelin company's "Hindenburg" and the completion in 1938 of its sister ship, the new "Graf Zeppelin." At the outbreak of World War II in 1939, only two nations were positively known to possess airships. The U.S. was operating nonrigids for coastal patrol; Germany possessed the old and new "Graf Zeppelin." France had discontinued its airship service in 1937, and nothing had been heard after 1938 of Russian activity, about which previously little had definitely been known.

As the war progressed, nazi directives ordered the dismantlement of Germany's two airships, and Allied bombings in 1944 destroyed the Zeppelin company's hangars and production facilities. While the war ended Germany's airship activity, it provided a great stimulus to that of the U.S. The U.S. navy, realizing the antisubmarine value of the blimp (popular term for nonrigid airship), embarked upon a lighter-than-air expansion program which resulted in the operation of almost 200 blimps from bases in North and South America, Europe and Africa.

The post-World War II period of aeronautical development began with only two nations, the U.S. and the U.S.S.R., engaged in airship activity. Soviet lighter-than-air operations were disclosed in late 1945 by press releases reporting flights by the airship "Victory," while the completion of another ship, the "Patriot," was announced in Nov. 1946. The U.S. navy's airship service, meanwhile, was continued on a reduced peacetime scale with an emphasis upon training and experimentation and with antisubmarine or utility services to the U.S. fleet being provided by operational blimp squadrons.

United States civil airship activity was resumed with the operation of blimps by three concerns for commercial or advertising purposes.

## DEVELOPMENT OF AIRSHIPS BY NATIONS

The development of the airship was international and primarily reflected the lighter-than-air efforts of Germany, Great Britain, France, the U.S. and, in the 1930s, of the U.S.S.R. Other nations, however, including Italy, Spain, Poland, Switzerland and Japan, engaged in airship operations at one time or another, but their activity and therefore their accomplishments in this field were limited.

**Germany.**—Although the success of the rigid airships of Count Zeppelin's Luftschiffbau-Zeppelin company dominated the German lighter-than-air picture, there were nevertheless other German dirigible constructors. Maj. August von Parseval in 1906 constructed for the German army the first in a series of some 28 Parseval pressure type airships which were built from that date until 1929. In 1907, a semirigid airship was constructed for the imperial German government by Maj. von Gross and Nikolas Basenach. Some four additional Gross-Basenach ships were built; the last, completed in 1913, had a speed of 51 m.p.h. and saw service with the German navy in the Baltic sea.

Count Zeppelin's competitors in German rigid airship development were Johann Schütte and Heinrich Lanz who in collaboration evolved a rigid design, using a spirally disposed wooden girder type of construction. Their first ship, a 700,000 cu.ft. capacity, 430-ft.-long, 60-ft.-wide craft, was completed in 1911 and attained a speed approaching 50 m.p.h. The last Schütte-Lanz airship (22nd in the series) was completed in June 1918.

Meanwhile, the success of the Zeppelin type had led to the foundation in 1910 of the Deutsche Luftschiffahrts-Aktien-Gesellschaft, commonly known as Delag, which was a transportation company organizing commercial and pleasure flights in airships until the outbreak of World War I in 1914. During these five years, Delag's five Zeppelins made about 1,600 flights, carrying 37,250 passengers without injury.

During World War I, 88 Zeppelins were built at four Zeppelin fabrication plants. These ships operated under the German army and navy for North sea patrol, scouting and for bombing of strategic areas, although they were gradually rendered ineffective in the latter mission by improvement of Allied defense means. Under the pressure for greater range and larger bomb loads and in order that they might fly higher and faster, the Zeppelins underwent remarkable improvement during this period. By 1918, size had increased to 2,400,000 cu.ft., speed to 80 m.p.h., useful lift to 50 tons, and ceiling to more than 20,000 ft. The Zeppelins were armed with machine guns mounted in the cars and atop the hull; they also had a subcloud car which could be lowered beneath the clouds. An observer in this car could navigate or direct bombing while the airship remained hidden above. (*See* AIR RAIDS.)

Zeppelin activity temporarily ceased with the capitulation of Germany in 1918. Existing Zeppelins were sabotaged by their crews, dismantled or delivered to France, Italy, England, Belgium and Japan. Two small commercial Zeppelins, the "Bodensee" and "Nordstern," were built immediately following the Armistice, but were surrendered to Italy and France respectively in 1921.

The next Zeppelin airship was the 2,470,000 cu.ft. LZ-126 which was constructed as a war reparations payment to the U.S.; this airship, later christened the "Los Angeles," was delivered to the U.S. by a transatlantic flight in Oct. 1924. The "Graf Zeppelin" (LZ-127), a 3,708,600 cu.ft. ship, was completed in Sept. 1928; this airship saw nine years of successful continuous service. When decommissioned in 1937, the "Graf Zeppelin" had made 590 flights (including 144 ocean crossings) and had flown 1,053,391 mi., carrying 13,110 passengers and 235,300 lb. of mail and freight. Hugo Eckener, successor to Count Zeppelin who died in 1917, commanded the ship on a 21,700 mi. world flight, completed in an elapsed time of 20 days and 4 hours in 1929. (*See* also TRANS-OCEANIC AND TRANS-CONTINENTAL FLIGHTS.)

The LZ-128 did not progress far beyond the blueprint stage and was followed by the 7,063,000 cu.ft. "Hindenburg" (LZ-129), completed in 1936. This 803-ft.-long airship, of conventional Zeppelin design with 36 longitudinal girders and 15 wire-braced main transverse frames, was powered by four 1,100 h.p. Mercedes-Benz diesel engines which gave the ship a maximum speed of 84 m.p.h. At a cruising speed of 78 m.p.h., the "Hindenburg," which contained accommodations for 50 passengers within its hull, had an 8,750 mi. range. In 1936, this airship operated the first commercial air service across the North Atlantic by carrying 1,002 passengers on 10 scheduled round trips between Germany and the U.S.; eastbound crossings averaged 65 hr., westbound, 52 hr. On May 6, 1937, while landing at Lakehurst, N.J., on the first of its 1937 season of North Atlantic crossings, the hydrogen inflated "Hindenburg" burst into flames and was completely destroyed with a loss of 36 lives—including the first passenger fatalities in the history of commercial airship operation. The fire was generally attributed to a discharge of atmospheric electricity in the vicinity of a hydrogen leak.

The LZ-130, bearing again the name "Graf Zeppelin" was completed and tested in Sept. 1938. Designed for helium operation, this slightly modified sister ship of the "Hindenburg" was built for transatlantic commercial service, but the tense international situation at that time and the refusal of the U.S. to export helium prevented the use of the ship for such a purpose. Inflated with hydrogen, the LZ-130 made a limited number of exhibition and test flights over Germany but saw no commercial or war service.

With the completion of the LZ-130 in 1938, work was begun on the LZ-131 but, as the outbreak of World War II approached, the German government in July 1939 directed the Zeppelin company to discontinue all lighter-than-air manufacture. Finally, in April 1940, another nazi directive ordered the dismantlement of the LZ-130, the old decommissioned "Graf Zeppelin" (LZ-127) and the main Zeppelin operating terminal at Frankfurt-on-Main; the reason given was the war need for duralumin and steel. Later, in July 1944, Allied bombings of Friedrichshafen resulted in the destruction of the hangars, shops and production facilities of the Zeppelin company, then engaged in the production of miscellaneous war materials.

**Great Britain.**—Prior to World War I, the British made little contribution to airship development, although a few private experimenters, notably Henry Spencer, Dr. Barton and E. T. Willows, aroused sufficient interest to cause the government to begin airship construction in 1907. From that date to the outbreak of hostilities in 1914, about eight British pressure airships, varying in volume from 21,000 to 180,000 cu.ft., were constructed, while an additional five were purchased from France and Germany. A rigid, the 660,000 cu.ft. "Mayfly," designed along Zeppelin lines, was completed in 1911; this ship never flew because it broke in two the same year while being brought out of its shed at Barrow. The failure of the "Mayfly" temporarily halted British rigid airship construction until 1914.

During the war period of 1914–18, seven nonrigid types were evolved for antisubmarine, antimine and coastal patrol duties. Ranging in size from the 60,000 cu.ft. S.S. type to the 360,000 cu.ft. North Sea class, these airships attained speeds as high as 58 m.p.h. and one, the NS-11, made a flight of 101 hr. endurance in 1919. A total of 207 nonrigid airships was built or used by Great Britain from 1914–18; of this number, 56 were in active service from June 1917 to Oct. 1918, during which time they flew 59,704 hr. and sighted 49 submarines. More than 9,000 patrol and 2,200 escort missions were carried out from 17 airship stations and 12 mooring-out sites. Nonrigid activity ceased shortly after the termination of the war, but one commercial blimp, the 60,000 cu.ft. AD-1, was constructed in 1929.

Rigid construction was resumed in 1914 when work was begun on the R-9; this second British rigid was completed three years later. Six rigids (two modified to abolish external keels) of the R-23 class were next laid down, followed by the R-31 and R-32, which were of wooden construction. None of these airships, however, equalled the products of the experienced Zeppelin designers and constructors. When the German Zeppelin L-33 was shot down in good condition over Essex in 1916, it served as a model for the next British rigids, the R-33 and R-34 which were completed in 1919 and were marked in their improvement in construction and performance; in fact, the R-34 had sufficient range to complete a transatlantic flight to Mineola, N.Y., the same year —the first transoceanic airship flight. Two additional rigids, the R-80 and R-36, were launched in 1920 and 1921. They were followed by the 2,700,000 cu.ft. R-38, which was to be purchased by the U.S. navy. Delivery by air was planned, but on its fourth trial flight, on Aug. 24, 1921, the craft broke in two and fell into the Humber river, killing 44 British and U.S. airship officers and men. The R-38 disaster brought British service airship activity to a halt, but in 1924 there was undertaken an empire communications scheme which provided for the construction of two commercial 5,000,000 cu.ft. rigid airships, the R-100 and R-101. Both were completed in 1929, the former by the Airship Guarantee company at Howden, the latter by the Royal Airship works at Cardington. The R-100, with accommodations for 100 passengers, was built on a modified Zeppelin design with six gasoline engines. Its two-year life was uneventful, although in July 1930 it flew to Montreal, Quebec, in 78 hr., returning the following month in 58 hr. The R-101, which was lengthened subsequent to completion to increase its lifting capacity, accommodated about 50 passengers

and deviated substantially from Zeppelin practice by using steel girders and five diesel engines. On an attempted flight, Oct. 5, 1930, to India, the R-101 crashed into a hill during a storm near Beauvais, France, and burst into flames, killing 46 persons. Following this disaster, the government scrapped the R-100 in 1931 and abandoned airship activity indefinitely.

**France.**—In spite of the broad French background in early lighter-than-air development, French interest lapsed appreciably after A. Santos-Dumont demonstrated his series of airships. The first significant modern airship of native French design was the Lebaudy brothers' "Jaune" (1902), which resulted in an order from the ministry of war for a slightly larger version. The success of the Lebaudys encouraged others to undertake lighter-than-air manufacture. From 1904 until the outbreak of World War I, pressure airships for the French government, for private use and for export were constructed in appreciable numbers by the Astra, Clément-Bayard, and Zodiac firms and by the government's airship factory and development centre at Chalais-Meudon.

During World War I, about 30 airship types were produced, with capacities ranging from 70,600 cu.ft. to 501,100 cu.ft. The French army, which had possessed about 16 airships during the war period, abandoned its airship activity in 1917, transferring 8 ships to the navy for operation. With an additional 52 airships, the French navy in 1917–18 performed more than 3,300 flights totalling 16,000 hr.; these airships were said to have attacked 60 U-boats and sighted 100 mines.

After the Armistice, considerable governmental interest was shown in rigid airships, of which type only one had previously been constructed in France. This had been the none too successful "Spiess," a privately owned wooden rigid built by the Zodiac society in 1912. Three Zeppelins, the L-72, LZ-113 and the small commercial "Nordstern," were turned over to France by Germany in 1920–21. The latter two saw little active service prior to dismantlement, but the 2,470,000 cu.ft. L-72 (renamed the "Dixmude" by the French) established an endurance record of 118 hr. 41 min. in Sept. 1923. In December of the same year, the "Dixmude" was lost over the Mediterranean with its entire complement; this disaster brought about the termination of rigid activity in France.

Despite the loss of the "Dixmude," French naval nonrigid and semirigid airship activity continued. From the end of World War I to its disestablishment in 1937, the French naval airship service operated an average minimum of two ships without a serious accident or fatality; the main operating base was Rochefort. All airships built during this period were constructed by the sole remaining French airship manufacturer, the Zodiac society, which from 1924–37 produced ten airships (six nonrigid, four semirigid) for the navy; the smallest was a 130,000 cu.ft. Vedette, the largest a 350,000 cu.ft. Escorteur.

In 1936, Zodiac developed for the French army a 35,000 cu.ft. motorized observation balloon with an attachable power and control gondola, so that it could be flown as an airship to alternative positions. This balloon went into mass production in May 1940, during which month 21 were completed. Additional motorized balloons were not produced because of the defeat of France the following month, but several were subsequently seized by the Germans for use against the U.S.S.R. The termination of navy airship activity by government decree in 1937 and of similar army activity by German conquest in 1940 was made all the more complete by Allied bombings of airship hangars and by other war destruction. French post-World War II aviation plans therefore included no provisions for lighter-than-air development; no governmental or private airship construction was planned although the sport of free ballooning was revived in 1945–46 to such an extent that the manufacture of balloons was recommenced by Zodiac.

**Italy.**—Most Italian airship construction concerned itself with the development of the semirigid type, in which Italy was soon acknowledged to be the leader. Several P- and M-type airships, 166,000 cu.ft. and 424,000 cu.ft. respectively, were designed and built by Gen. A. Crocco and Ricaldoni prior to World War I; several Forlanini type semirigids had similarly been completed by the beginning of hostilities. During the World War I period of 1914–18, additional types were developed, primarily to increase altitude performance for bombing missions.

Although receiving three Zeppelins from defeated Germany in 1920–21, the Italians made little or no effort to explore the possibilities of the rigid airship; indeed, improper handling resulted in wrecking two of these Zeppelins before they had been in Italian possession one year. In 1921, a 1,240,000 cu.ft. semirigid, the "Roma," was sold to the U S. army; this 410-ft.-long airship was shipped disassembled to the U.S. where it was re-erected. During a test flight on Feb. 21, 1922, the "Roma" became unmanageable, crashed into a high tension wire and burned, killing 34 persons. The well-known N-type Italian semirigid was developed by Gen. Umberto Nobile and was the last airship type undertaken under government cognizance when Italy officially terminated its airship program in 1927. On May 11, 1926, the 654,000 cu.ft. "Norge" (N-1), carrying an expedition headed by Roald Amundsen, Lincoln Ellsworth and Nobile, left Spitzbergen for the north pole. The "Norge" passed over the pole on May 12 and, continuing its 3,000-mi. flight, landed 2 days later at Teller, Alaska, where it was dismantled. The N-3, third of the Nobile N-series, was sold to Japan where it was destroyed during naval manoeuvres in Oct. 1927. Using the "Italia" (N-4), Nobile attempted another polar flight in May 1928, but after reaching the north pole, the ship crashed on its homeward journey with a loss of seven lives. The "Italia" affair and its unpleasant repercussions signalled the end of airship development in Italy, and Nobile later went to Russia to practise his art of semirigid airship design.

**Russia.**—Although Russia had shown a pre-World War I interest in airships by purchasing semirigids from France, there was little concerted activity until about 1931 when a public subscription of 15,000,000 rubles toward an airship program was announced. The second five-year plan provided for the operation of airships on civil air routes within the Soviet Union, and to assist this program the services of Gen. Umberto Nobile, Italian designer of semirigid airships, were secured. A number of small pressure airships were subsequently constructed, and in 1933 plans were announced to lay down a 1,304,620 cu.ft. commercial ship at Dolgo Prutnaja, 19 km. from Moscow, and one of 705,200 cu.ft. at Leningrad. The former, like the 2,820,000 cu.ft. metal-clad also announced as planned, was presumably never built. The Dirigiblestroi or Dirigible Construction trust in 1936 began the 353-ft.-long 882,829 cu.ft. semirigid DP-9. In 1937 a Russian airship commission visited the U.S. to study American airship efforts. In September of the same year, the 650,000 cu.ft. semirigid V-6 established an endurance record of 130 hr. 27 min. (This record stood until Nov. 1946 when it was broken by 40 hr. by the U.S. navy blimp XM-1.) The V-6 was destroyed with the loss of 13 lives in 1938 when it crashed into a mountain while participating in rescue operations to assist soviet scientists marooned on a drifting polar ice flow. In May 1938, the V-10 began its trials at Moscow, and the V-8 was reportedly still under construction for a proposed commercial route between Moscow and Leningrad.

Nothing was heard of Russian lighter-than-air activity during World War II. In late 1945 it was disclosed that a small civil airship, the "Victory," had made an 80 hr. demonstration flight over the Black sea. In Nov. 1946, the existence of another soviet airship, the "Patriot," was announced; this 150-ft.-long craft was reported to be dual engined and capable of carrying 12 passengers with a 1-man crew. Helium resources exist in the U.S.S.R. and it was probable that this noninflammable gas was being used as an inflation medium for soviet airships.

**United States.**—A number of small privately-owned pressure airships were built and flown by Capt. Thomas S. Baldwin, Lincoln Beachey and Roy Knabenshue immediately following the beginning of the 20th century. The first practical U.S. airship was Baldwin's "California Arrow" (1903), while the first U.S. government airship was a 19,500 cu.ft. craft bought from Baldwin by the U.S. army in 1908. Two unsuccessful attempts to fly to the north pole were made in 1907 and 1909 by the explorer Walter Wellman in his airship "America"; using the same craft, Wellman in 1910 attempted a transatlantic flight which similarly failed. In

1912, Melville Vaniman took off from Atlantic City, N.J., for a transatlantic flight in the "Akron," but within 15 min. after departure, the airship caught fire and was destroyed with the loss of its entire crew of 5.

Naval airship activity began when the 175-ft.-long, 114,800 cu.ft. capacity, DN-1 was contracted for in 1915. Erected in a floating hangar at Pensacola, Fla., the DN-1 (later redesignated the A-1) was completed in April 1917; the craft proved unsatisfactory because of excessive gas leakage and was abandoned after three flights.

In 1917, with war clouds on the horizon and serious attention being given to the development of nonrigids for antisubmarine and coast patrol duties, the navy ordered 15 B-type airships (77,000 to 84,000 cu.ft.), which were completed in 1917–18 by the Goodyear Tire and Rubber company, Goodrich Tire and Rubber company and Connecticut Aircraft company. The B-class was followed by the 182,000 cu.ft. C-type, for which 30 (reduced to 10 after the Armistice) were contracted with Goodyear and Goodrich; the first C-ship was completed in Sept. 1918. During U.S. participation in World War I, U.S. navy blimps were based at seven Atlantic coast air stations from Chatham. Mass., to Key West, Fla., while other airships, acquired from the French, were operated from Paimboeuf, France. In May 1919, the C-5 attempted a transatlantic crossing; after flying from Montauk, Long Island, N.Y., to Newfoundland in 23 hr., the blimp was lost when strong winds tore it away crewless from its mast and blew it to sea.

Five D-type airships (189,000 cu.ft.) were next built by Goodyear and Goodrich. A considerably modified D-ship, the D-6, was later produced by the navy. In 1918 and 1919, Goodyear built three small, single engine, nonrigid airships, of which two, designated the E-1 and F-1, were purchased by the navy. A 400,000 cu.ft. G-ship design was completed in 1919, but no ships of this type were constructed. The designation G was later applied to a class of utility and training ships (183,000 to 196,700 cu.ft.) which began with the G-1 (ex-Goodyear "Defender") acquired in 1935. The first and only navy semirigid airship was the O-1, erected at Cape May, N.J., in Sept. 1919; imported from Italy, this craft saw only three months' service. In 1921, Goodyear completed for the navy the 43,000 cu.ft. H-1, a single engine airship which could be towed or used as a kite balloon. The next naval airship type was the J-ship, of which the first unit was completed in 1922.

Meanwhile, the U.S. army, which had no World War I airship program, undertook such development in 1919, with a joint services agreement that its program would concern itself with nonrigid and semirigid development, while the navy would concentrate on rigid airship activity. The army acquired several blimps from the navy and constructed main airship bases at Langley Field, Va., and Scott Field, Ill. A number of nonrigids, particularly of the TC-class, were constructed for the army which, in addition, to investigate the semirigid design, purchased the "Roma" from Italy in 1921 and the 719,000 cu.ft RS-1 from Goodyear four years later. The 1,240,000 cu.ft. Italian-built ship was destroyed with the loss of 34 lives on Feb. 21, 1922, when it burned after striking a high tension wire at Langley Field, Va. The RS-1, after several years of intermittent service, was dismantled, and the army concentrated thereafter on nonrigids and motorized balloons. Finally, in 1937, the army terminated its airship program and turned over its nonrigids to the navy.

Entrusted with rigid airship development, the navy began construction of the 2,115,174 cu.ft. ZR-1 in 1919. Fabricated at the Naval Aircraft factory, Philadelphia, Pa., and assembled at the Naval Air station, Lakehurst, N.J., this ship, christened the "Shenandoah," was largely a copy of the German Zeppelin L-49 design, modified for mooring mast and helium operation. Her maiden flight on Sept. 4, 1923, was followed by a number of noteworthy flights including a 9,000 mi. transcontinental trip. On Sept. 3, 1925, the "Shenandoah" broke into three parts in a line storm over Ohio, killing 14 members of her crew of 43.

That no fire accompanied the "Shenandoah's" destruction, thereby enabling 29 crew members to free balloon the hull sections to earth, was undoubtedly due to the noninflammable helium with which the ship was inflated. Helium had been adopted as the sole inflation medium of army and navy airships following the burning of the former's hydrogen filled "Roma" in 1922. The first U.S. airship inflated with helium had been the army's C-7 in Dec. 1921.

The purchase of the British rigid R-38 (U.S. navy designation, ZR-2) was authorized in 1920 with accompanying arrangements for the instruction of U.S. personnel in British rigid airship technique. This 2,700,000 cu.ft. ship was destroyed on Aug. 24, 1921, with the loss of 16 U.S. airship officers and men when it broke in two during its fourth trial flight in England.

On Oct. 15, 1924, the German Zeppelin company delivered the 2,470,000 cu.ft. ZR-3, later christened the "Los Angeles," to Lakehurst, N.J., after a 5,000 mi. flight from Friedrichshafen where the ship had been constructed as a war reparations payment to the U.S. This 658-ft.-long dirigible was used extensively for experimental work on flight and mooring problems and developed a means for hooking-on and releasing aeroplanes in flight. After 331 flights for a total of 4,320 hr., the "Los Angeles" was decommissioned at Lakehurst in 1932 and dismantled 7 years later.

The German Zeppelin patents and processes together with the services of key Zeppelin personnel were acquired in 1924 by the Goodyear Tire and Rubber company, which formed a subsidiary, the Goodyear-Zeppelin corporation, in Akron, O. In 1928, Goodyear-Zeppelin began the construction of two 6,500,000 cu.ft. rigid airships for the navy. Both ships were 785 ft. long and 133 ft. in diameter, with a cruising range of 6,500 mi. and a maximum speed of 72 knots. The power plant installation was novel, with each ship having eight 560 h.p. Maybach engines mounted in separate engine rooms within the hull and driving propellers so mounted on outriggers that they could be swivelled to produce a vertical lifting component. To compensate for weight lost through fuel consumption, water recovery apparatus was installed with exhaust condensers mounted on the hull above the engine rooms. Each ship also carried a trapeze for the landing and launching of aeroplanes and possessed an internal hangar for five planes. The "Akron" (ZRS-4) was completed in 1931 but, after about 1,200 hr. of service, crashed with the loss of 73 lives on April 4, 1933, in a storm off the New Jersey coast. Her sister ship, the "Macon" (ZRS-5), was launched the same month and operated primarily from the new airship base at Sunnyvale, Calif.; previous rigids had all been based at Lakehurst. On Feb. 12, 1935, while returning from fleet manoeuvres, the "Macon" suffered failure of her upper fin structure, resulting in loss of control. With severe gas leakage and accompanying structural collapse, the "Macon" settled to the sea and slowly sank off the California coast; all but two crew members were rescued.

The loss of the "Macon" left the navy without an operational rigid airship and led to numerous naval, governmental and civil investigations to determine the safety and practicability of rigid airships. Since the results of these investigations endorsed further dirigible construction, a 3,000,000 cu.ft. navy rigid was authorized in 1938. However, money appropriated by congress to begin its construction reverted to the treasury after delays in selecting the design and size; subsequent funds were not voted, and the ship never progressed beyond the drawing board stage.

In the period between World Wars I and II, United States civil airship activity was primarily limited to the operation of commercial and advertising blimps by the Goodyear company, constructor of virtually every significant U.S. airship after 1911. After experimenting with a small "pony blimp," Goodyear in 1925 began the operation of from one to six of its own nonrigid helium inflated airships, which pioneered many airship flight and ground handling improvements. The capacity of these Goodyear blimps varied from 51,000 cu.ft. to 183,000 cu.ft. but was later standardized at 123,000 cu.ft., a size which carried 6 passengers. From the beginning of these commercial operations in 1925 until the transfer of the Goodyear blimp fleet to the navy in 1942 for war duty, Goodyear airships made 152,441 flights and carried 407,171 passengers without a single passenger injury or fatality.

In 1935, with rigid airship activity ended by the crash of the "Macon," naval lighter-than-air efforts again centred about nonrigid development. At that time, the navy was operating the 210,000 cu.ft. J-4, the 320,000 cu.ft. K-1, and the 202,000 cu.ft. ZMC-2. The J-4 was an open gondola ship completed in 1924, while the K-1, completed in 1931, used Blau gas as well as gasoline for fuel. The ZMC-2, first successful all metal airship, was constructed in 1929 by the Metalclad Airship corporation of Detroit, Mich. Its hull consisted of 24 longitudinals and 12 circular frames to which an .0095 in. thick outer cover of alclad sheet was riveted. Although possessing certain rigid construction characteristics, the ZMC-2 was nevertheless a pressure airship depending upon internal pressure to maintain hull rigidity in flight. While the craft had a long successful life prior to dismantlement, no other metal-clads were built. The 183,000 cu.ft. Goodyear-owned "Defender" was acquired by the navy in 1935 and designated the G-1. Two years later, upon abandonment of the army airship program, the navy received the former army TC-13 and TC-14, nonrigids of about 350,000 cu.ft. capacity.

Increased airship strength was authorized as the entry of the United States into World War II drew near, and at the time of Pearl Harbor the navy was operating 4 new K-type patrol airships (built 1938–41), 3 small L-type trainers (built 1938–41), the G-1 and the TC-13 and 14. The airship building program was speeded up and an improved G-type and new M-type ship evolved. During the war period, the navy operated a total of 134 K-type (425,000 cu.ft.) and 4 M-type (647,500 cu.ft.) patrol airships, 22 L-type training ships of 123,000 cu.ft. capacity and 8 G-type (196,700 cu.ft.) training and utility blimps.

Except for those used primarily for training and experimentation, U.S. navy airships of World War II were grouped into 14 U.S. fleet blimp squadrons which, operating from more than 50 main and auxiliary bases, performed antisubmarine patrol and escort operations in a 3,000,000 sq.mi area along the U.S. Atlantic, Gulf and Pacific coasts, in the Caribbean, along the South American coast from Panamá to Rio de Janeiro and in the Mediterranean. A U.S. fleet blimp utility squadron similarly operated from five bases along the Atlantic seaboard. These 15 squadrons flew a total of 55,900 flights for 550,000 hr. and escorted 89,000 ships without the loss of a single vessel to enemy action. Of the blimps assigned to fleet units, 87% were in operational readiness at all times, thereby establishing a record availability for military aircraft.

The year 1944 marked the peak of World War II airship operation; at that time, naval lighter-than-air flight personnel numbered 1,500 officer pilots and 3,000 enlisted air crewmen; ground administrative and maintenance personnel amounted to 706 officers and 7,200 enlisted men.

The first nonrigid airship transoceanic flight was made in 1944 when blimp squadron 14 was ordered based with six K-ships at Port Lyautey, French Morocco, for patrol of the Straits of Gibraltar. The blimps were ferried across the Atlantic in pairs from South Weymouth, Mass., via Newfoundland and the Azores. The first flight (3,145 mi.) was made on May 29–June 1, 1944, by the K-123 and K-130 in a total flight time of 58 hr. In 1945, two additional K-ships were flown to Port Lyautey from Weeksville, N.C., via Bermuda and the Azores; the 3,532 mi. flight was completed in a flight time of 62 hr. Another transatlantic airship movement was planned in May 1945 when the navy, recognizing the value of the airship in visual and instrumental detection of U-boats, ordered a blimp squadron based in southwest England. This move was cancelled just prior to execution because of the capitulation of Germany.

Although antisubmarine operations were the main duties of U.S. navy airships during the war, it was found that their unusual flight characteristics were valuable in the fulfilment of general utility missions. Torpedo recovery, aerial photography, observation, special equipment calibration, search operations, rescue work and other services requiring slow speed, low altitude operations for extended periods of time were performed in great numbers and variety for fleet and shore units. In the Mediterranean, the airships of squadron 14 assumed an unprecedented importance in mine sweeping operations through spotting and marking otherwise undetected mine fields and through saving a number of sweeping vessels by diverting them from collision courses with mines they could not see.

With the end of hostilities in 1945, the active naval airship organization was reduced to two operational U.S. fleet blimp squadrons plus an extensive training and experimental program at Lakehurst, war and postwar headquarters of naval lighter-than-air activity. The activation of a naval reserve airship training program was also planned. As part of Lakehurst experimentation to determine the sea-keeping and habitability features of airships, the 725,000 cu.ft. XM-1 (formerly the 647,500 cu.ft. M-1) on Nov. 2, 1946, established a 170 hr. 17 min. world's aircraft endurance record for continuous unrefuelled flight.

Civil airship activity was resumed in 1946 with the purchase and operation of surplus navy K- and L-type blimps for advertising purposes by the Goodyear company, Douglas Leigh Sky Advertising corporation and Hughes Aircraft corporation.

## AIRSHIP OPERATION AND CONSTRUCTION CONSIDERATIONS

This discussion is limited to the nonrigid airship and omits consideration of rigid activity because of its world-wide termination in 1940 with the dismantlement of the German Zeppelin LZ-130.

**Flight Principles.**—An airship or balloon floats in the air whenever the sum of the weight of the gas container (and any structural weights or other loads hanging therefrom) plus the weight of the very light lifting gas is the same as or less than the weight of the air which the airship or balloon displaces. This Archimedean precept is the fundamental principle of airship flight. Airships lighter than the air they displace experience a buoyant force tending to make them ascend; those which are heavier will tend to descend. The lift acquired by an airship from the buoyancy of its gas is known as static lift.

When a lighter-than-air craft is buoyant, it is in a "light" condition. When its weight and static lift are equal, it is "in equilibrium"; it is "heavy" when its weight exceeds its static lift. An airship is also subject to dynamic lift derived from its motion through the air. While its hull is by no means an efficient airfoil, its size produces an appreciable lifting effect when driven through the air at an inclination. The "heavy" airship utilizes this dynamic lift of the hull and fins as well as static lift and, like an aeroplane, becomes airborne by means of a take-off run on its landing gear. U.S. navy blimps have taken off as much as 6,000 lb. "heavy." "Light" airships are sufficiently buoyant to become airborne without a take-off run. While blimps which are "heavy" fly at a slight inclination to make use of the lifting effect of the air flow, "light" airships conversely fly slightly nose down, so that the air flow against the top side of the envelope will counteract the lightness and the constant static tendency to gain altitude The static condition of airships varies in flight, depending upon such factors as the amount of fuel consumed (each gallon of gasoline weighs six pounds) and changes in weather conditions. Extreme heaviness can be remedied by ballast expenditure while excessive lightness can be overcome by picking up sea water or other ballast and valving lifting gas.

Normal control of altitude is maintained neither by the expending of ballast nor by the valving of helium. To ascend, "up elevator" is given, raising the airship's elevators which are flippers attached to the horizontal fins. The air flow about the moving airship strikes these raised surfaces and depresses the tail, thus lifting the nose; the engines drive the ship upward. To descend, "down elevator" raises the tail and lowers the nose, enabling the motors to drive the ship earthward. Rudder control is similarly exerted; the air flow, striking the rudder surfaces (attached to the upper and lower vertical fins), turns the tail, hence the nose, in the desired horizontal direction. The control of an airship in many respects resembles that of a submarine, the blimp's elevators and rudders corresponding to the undersea craft's diving planes and rudder.

**Lifting Gases and Pressure Control.**—At sea level and at standard conditions, air weighs about 81 lb. per 1,000 cu.ft. There

are only a few gases which give any practical lift in air, the most commonly used being hydrogen, helium and coal gas. Because of the weight of coal gas, its use is restricted to free balloons of limited performance. Pure hydrogen and helium weigh 5 and 11 lb. per 1,000 cu.ft. respectively, and their corresponding lifts are 76 and 70 lb. However, impurities generally present reduce these values to working figures of 68 lb. for hydrogen and 62 lb. for helium. The disadvantage of the lesser lift of the helium is offset by the noninflammable nature of the gas, an advantage which caused the U.S. to adopt a "helium only" policy in airship operation. The higher cost of helium (approximately $15 per 1,000 cu.ft. as against about $6 for hydrogen) plus the fact that its shipment and storage are complicated and expensive make it necessary that helium valving practice be much more conservative than that used with hydrogen inflation. (*See* HELIUM.)

In nonrigid airships, internal gas pressure and its maintenance between maximum and minimum safety levels are vital. A blimp flying with low pressure reduces the firmness of its envelope and is endangered by the possibility that the air flow might cause the bag to fold or buckle. On the other hand, excessively high pressure places undue strain on the envelope, perhaps causing it to rip were it not for helium valves which automatically operate when the pressure exceeds the safety limit. This problem of maintaining proper pressure is aggravated by the eccentricities of gases which continually expand and contract because of temperature and altitude changes. To compensate for these changes in helium or hydrogen volume, nonrigid airship envelopes contain air compartments known as ballonets.

The 425,000 cu.ft. envelope of a K-ship (representative of standard airship design) consisted of one helium chamber and two ballonets. When the envelope was inflated with helium to its maximum capacity, the gas chamber contained 425,000 cu.ft. of helium and the air ballonets were empty. If during flight a decrease in temperature or altitude caused the 425,000 cu.ft. of helium to contract to 400,000 cu.ft., the operation of the ballonets ensured the maintenance of constant and adequate pressure. As the 25,000 cu.ft. of helium disappeared through contraction, an electric blower or the propeller slip stream blew an equivalent volume of air into the ballonets which inflated within the envelope, thereby replacing the missing helium and keeping the pressure constant. If the gas later expanded to a volume of 410,000 cu.ft., 10,000 cu.ft. of air were then released from the ballonets by automatic valves. The total capacity of the K-ship's two ballonets was 114,000 cu.ft.—slightly more than one-quarter of the total bag volume. By means of these air ballonets, K-ship helium pressure was maintained at a point equivalent to the weight of 1.5 in. of water. Ballonets, because of their fore and aft locations, may also be utilized for trimming purposes.

**Construction Details.**—A modern nonrigid airship envelope ordinarily consists of three layers of long staple cotton fabric impregnated with rubber. The envelope is divided into a system of gores and panels, the seams of which are lapped, cemented, sewed and taped to reduce gas leakage which is still further discouraged by coating the envelope's inner side with paraffin. An aluminum paint on the outer side reflects the sun and reduces the amount of heat absorption by the envelope, thereby helping to minimize the degree of helium expansion. Battens, which are fabric covered strips of wood laced to the envelope, reinforce and stiffen the blimp's nose to avert its buckling at high speeds.

The car or gondola in modern nonrigid airship practice is suspended against the bottom of the envelope by a system of internal and external catenary curtains. The internal catenaries, consisting of strong fabric mounted in parallel rows running fore and aft, hang down from the top inside the envelope. From these curtains suspension cables extend to the framework of the car. Another catenary curtain is located outside and at the bottom of the envelope; to this external suspension system, the top of the car is affixed.

Personnel, armament, power plants and virtually all the equipment of a nonrigid airship are carried by its car, which rests upon a wheel (sometimes retractable) to make possible wheel ("heavy") take-offs and landings. The power plants, usually aeroplane type gasoline engines, are mounted on outriggers extending from either side of the car; access to the engines is possible in flight. Because of their large size (42 ft. in length for the K-ship, 115 ft. for the M-ship), airship cars possess good habitability characteristics and are fitted with the finest communications and navigational equipment.

Each blimp is equipped with a number of ropes and lines used in ground handling operations to steady and hold the ship in position or to pull a "light" craft to earth.

At the extreme bow of the airship is a round disk mounting a horizontal spindle to which a cone is attached. The mooring of an airship is normally accomplished by fitting this cone into a cuplike device at the top of the mooring mast. With its nose held in this manner, an airship is docked, undocked or "walked" across the field by means of a mobile, tractor-towed, triangular-shaped, steel mast, in the case of a K-ship about 43 ft. high.

**Future Development.**—Although the U.S. navy's 725,000 cu.ft. XM-1 was at its time of building the largest successful nonrigid airship ever constructed, it by no means represented the maximum volume permissible with the nonrigid type of construction. Progress in the development of stronger and lighter envelope fabrics makes nonrigids exceeding 1,000,000 cu.ft. capacity entirely practicable. However, increased gas volume makes possible greater car loading; this increased weight, when concentrated in a short car, imposes considerable strain on the catenary curtains and envelope. Accordingly, modern airship practice calls for a proportionately longer car to provide a more equitable weight distribution on the bag. In the case of the XM-1, its 115-ft.-long car was built of three sections integrated by universal joints to provide a degree of flexibility.

With the development of improved power plants, it was considered in 1947 that a maximum air speed of about 90 to 100 m.p.h. was obtainable with standard established hull designs and propulsion methods. This figure, although low compared with aeroplane speeds, offers no great disadvantage to lighter-than-air development because the utility of the airship is derived not from its maximum speed but from its ability to conduct hovering or low speed, long endurance operations. One aspect of power plant improvement during World War II was the incorporation of electric reversible propellers to facilitate landing operations by slowing or stopping the forward motion of the ship so that it could be more readily taken in hand by the ground crew.

Under war demands, U.S. navy airships from 1942–45 operated daily under severe weather and climatic conditions, leading to the development of new operational techniques. For example, the landing of blimps in winds of 35 knots was in peacetime an emergency measure; in wartime operations, routine landings were made in these and in winds approaching 50 knots. The prewar notion that successful blimp operations necessitated expensive hangars and supporting bases was refuted in 1943 when K-ships began day and night operations from wooden stick masts at primitive isolated jungle bases with a minimum of equipment and personnel. During these South American operations, which were conducted a thousand miles or so from airship hangars, blimps were exposed to the rigours of the equatorial sun and the tropical rains. In so doing, they demonstrated their ability to operate in such fabric deteriorating conditions for months without other hangar availability than that necessary for routine overhaul or repair purposes. Of the 50-odd airship bases utilized by U.S. navy blimps during World War II, only 13 possessed hangar facilities. It was thought as experience was gained by continued operations, additional progress in operating and maintenance technique would follow. New developments in ground handling operations could additionally be expected as improved mechanical means were evolved for the landing, mooring, docking or undocking of airships with consequent reduction in ground crew personnel requirements.

The post-World War II employment of U.S. navy airships began with emphasis upon experimentation. Because of the large carrying capacity and the size of airship cars, the installation of heavy or bulky equipment is possible in airships which additionally are unusually stable airborne platforms. For this reason, air-

ships before and during World War II were used to pioneer, test and prove many aeronautical, scientific and technical advancements. Continuation of this activity in peacetime under the cognizance of the Lakehurst-based Naval Airship Training and Experimental command was authorized with promising prospects of improvements in airship antisubmarine, utility, mine spotting, and rescue devices and operating procedures.

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**AIRSHIP SHEDS.** The term airship shed is used synonymously with airship hangar or airship dock to denote a building or other structure in which airships are housed for construction, storage, repair or overhaul purposes.

Sheds are not normally essential for operations since both rigid and pressure airships can be "moored out" and operate from masts for extended periods of time. Airships can be serviced and given minor repairs at masts, and being capable of operating from aircraft carriers and specially fitted airship tenders, require hangar availability only for major repairs and overhaul or for protection from severe weather conditions.

When airships were small, their sheds were of simple barnlike construction with wooden or fabric walls and with swinging doors. Earliest hangars were built on the water or sometimes mounted on turntables, so that they could be turned into the wind. The advent of larger airships, however, seriously complicated shed design. It became necessary to develop mammoth structures devoid of interior supports, yet so designed that neither the shed nor its doors would seriously disturb the normal air flow over the airport, thereby complicating the landing and manoeuvring of airships.

The world's largest airship shed, completed by the Goodyear Tire and Rubber company at Akron, O., in 1929, is an arch-shaped structure with orange-peel doors—a design inaugurated by Germany prior to World War I. The Akron dock required about 7,500 tons of structural steel and has a floor area of 364,000 sq.ft. and a cubical content of 45,000,000 cu.ft. At each end there are two spherical-calotte doors which can be opened electrically in five minutes; each door weighs 600 tons, the weight being taken by 40 wheels running on circular railroad tracks. These orange-peel doors rotate about hinge pins in the roof, so that in the fully opened position they nestle along the arched sides of the shed. A similar type hangar with slight modifications and smaller dimensions was constructed about 1933 by the U.S. navy at Sunnyvale (later renamed Moffett field), Calif.

The extensive U.S. navy nonrigid airship (blimp) program of World War II brought about the construction of numerous airship bases and sheds along the U.S. Atlantic, Gulf and Pacific coasts. Two 960-ft.-long, 330-ft.-wide, 200-ft.-high steel hangars of orange-peel door design were erected at South Weymouth Mass., and Weeksville, N.C. Other hangars were needed, and to conserve steel a new type shed of wooden construction with concrete foundations was designed and erected at South Weymouth (1); Weeksville (1); Lakehurst, N.J. (2); Glynco, Ga. (2); Richmond, Fla. (3); Houma, La. (1); Hitchcock, Tex. (1); Santa Ana, Calif. (2); Moffett Field, Calif. (2); and Tillamook, Ore (2). These 17 hangars were, with slight modifications, identical in size and design. The dimensions of the 2 Lakehurst wooden

| | |
|---|---|
| Interior length, hangar deck | 1,026 ft. |
| Interior width, hangar deck | 235 " |
| Interior door opening, max. height | 120 " |
| Interior door opening, max. width | 220 " |
| Exterior hangar length, max. | 1,076 " |
| Exterior hangar width, max. | 297 " |
| Exterior hangar height, max. | 173 " |

sheds shown in the table in column one can therefore be taken as representative of the 15 others.

The wood which went into the construction of these sheds was chemically treated to make it fire resistant. Much of the structure was prefabricated; the truss joints of the wooden beams were bolted together. With the exception of the hangar at Houma, each shed mounts folding leaflike sectional doors which are 120 ft high supported on railroad rails at the top and bottom of the door sill. These doors fold away in recesses between twin reinforced concrete pylons on either side of the shed. The pylons support a box beam girder carrying the upper rail on which the electrically operated doors slide. The doors of the Houma structure are detachable and, when opened, move on railroad tracks off to one side completely apart from the shed. The three hangars at Richmond were totally destroyed by a hurricane and fire in Sept. 1945. Many of the world's most famous airship sheds, including those of the German Zeppelin company, were destroyed during World War II. The location and dimensions (in feet) of the larger sheds still remaining after the war, excluding the wartime U.S. navy steel and wooden hangars already described, are listed in the table. (*See* AIRSHIP.) (J. G. V.)

| | Length | Width | Height |
|---|---|---|---|
| Brazil: Rio de Janeiro | 886 ft. | 164 ft. | 161 ft. |
| England: Cardington (2 sheds) | 850 " | 180 " | 155 " |
| France: Cuers (Toulon) (2 sheds) | 770 " | 197 " | 150 " |
| India: Karachi | 850 " | 180 " | 155 " |
| U.S.A.: Akron, Ohio | 1,175 " | 325 " | 200 " |
| Moffett Field, California | 1,138 " | 310 " | 198 " |
| Lakehurst, New Jersey | 807 " | 264 " | 188 " |

**AIR SICKNESS:** *see* ANOXAEMIA.

**AIR WARFARE.** Military aviation came into being when Louis Bleriot flew across the English channel from Calais, France to Dover, England, on July 25, 1909. Many military men never realized the significance of that flight. Some more farsighted experts, however, began to readjust their ideas as to the warfare of the future. Napoleon had looked longingly across the channel but could not take his army across. Engineers had talked for years about putting a tunnel under the channel but the British objected that it would remove their isolation. Then Bleriot in a few minutes completely removed the bars to British isolation from the continent of Europe. What one aeroplane could do, certainly hundreds and thousands could do.

There was little done to make the aeroplane a practical, effective military weapon between 1903 and 1914. Isolated tests and experiments indicated that the device was capable of doing more in warfare than merely carrying messages and observing for the ground troops. As early as the fall of 1911, the United States army corps had tried out Riley Scott's aerial bomb release. It was many years ahead of its time as it mathematically figured out the proper point from which to drop the bomb to hit a target. The war department was not interested so Scott took his device to France, entered the Michelin contests for accurate bombing and easily won first prize. He had no competition and his hitting

target 375 x 124 ft. with 8 out of 15 bombs dropped from an altitude of 2,624 ft. was far beyond the conception of accuracy for any of the airmen or military men in Europe. As a result they bought the device.

In the spring of 1912 Col. I. N. Lewis, of the U.S. army, introduced a new type of machine gun. The type which was then in use was impractical in that it had a long feed slide which made the operation of the aeroplane controls impossible. However, the decision made in the war department was that the old Benet Mercier machine gun was standard for the army and would be standard for the aeroplanes. Lewis, following the precedent established by Scott, went to Europe for the sale of his gun.

These were two very important events in the history of military aviation. Two years later in 1914 World War I broke out in Europe. The Scott ideas had been incorporated into bombsight developments by that time, and the Lewis guns were installed as permanent equipment on some types of planes in European flying units. The small air corps of the world powers, however, went into World War I in Aug. 1914 still untried.

## WORLD WAR I

At the beginning of World War I, aircraft production had not as yet become a technique of jigs, dies, fixtures and special fittings. Each and every aeroplane was a handmade task. No country, not even France, supposed to be far more air-minded than any other nation, had available 400 combat planes in Aug. 1914.

The ideas of the general staffs were clear with regard to how they were going to employ their cavalry, artillery, infantry and their navies, but the aeroplane was still an unknown quantity. All agreed that it had great possibilities as a reconnaissance vehicle. It could go behind the enemy lines and locate troops, concentrations of reserves moving along the roads, and it might even find them in bivouac, even in woods. What else could the aeroplane be used for?

The air enthusiasts were sure that it could be used in combat against other planes, that it could be used to carry bombs and destroy predesignated targets, but how? So it was that World War I became one of the best proving grounds to develop the aeroplane as a combat weapon.

**Armament.**—The Lewis gun had been used on military aircraft but only for rear-seat firing. A fighter plane must have fire power from the front. The normal technique of air operations indicated that most aerial attacks should be made in that way. There was one major problem to be solved: how could a machine gun be fired through the propeller without hitting and destroying it?

There were numerous solutions suggested for this problem. At first the airmen flew past each other shooting such weapons as they might have in their hands—pistols, shotguns, rifles or machine guns. All those methods of solving the problem were far from satisfactory, as they seldom made hits. The next step was to mount a machine gun on top of the upper wing of a biplane so that it fired over the propeller. A sight mounted along the top of the fuselage made it possible for the gunner to get accurate aim, but the mounting was very unwieldy. It was hard to fix jams in the air and it was difficult to change drums of ammunition.

Next came the razor sharp steel pieces mounted at the rear of the propeller in the line of fire of a gun located in the fuselage. The bullets either went through the blades as they rotated or they hit the steel knife blades. If they hit the knife blades, no harm was done. The big step forward came when Anthony H. G. Fokker, a Dutch aeroplane designer working for the Germans in the fall of 1915, brought out the first synchronizing gear. This gear made it possible for the gun to be fired at will by the pilot through the propeller with no ill effects; the gun was so synchronized with the moving propeller that no bullet could hit the propeller blades. That device put Germany well ahead of the Allies insofar as fighter planes were concerned.

**Bombing.**—The bombing efforts went through the same cut-and-try procedure before a satisfactory bombsight, type of bomb or technique of operation was secured. The first bombs dropped were round hollow shells. The bombardier ignited the fuse by scratching a prepared plug in the bomb against a prepared surface along the sides of the aeroplane. If the fuse caught and he judged his timing right, the round shell might explode somewhere near the target.

The next step was to put fins on artillery shells and use them. About the same time some French airman conceived the idea of employing fluted darts, pointed at one end. It was figured that if enough of the darts were dropped, some of them might hit marching enemy soldiers on the head and penetrate in spite of the steel helmets. Such bombing technique was, to say the least, ineffective and inefficient.

The first bombsights were of simple construction and operation. All of the World War I planes had open cockpits, and the bombsight was mounted on the side of the fuselage. The bombardier bent his head over the side of the cockpit, made his adjustments and then pulled the trigger. The bomb release apparatus was created to eliminate the human error of dropping the bombs by hand and to prevent complicating the planes with attachment gear when large sized bombs were used. As the war progressed bomb release gear became standardized and could be attached to any type of plane.

**Formation Flying.**—The mission alone could not determine the trend in aeroplane design. Both the Germans and the Allies were out to shoot down as many hostile aircraft as they could either from the air or from the ground. So it became necessary to bring out formations which gave the most protection against hostile air attacks and provided the least vulnerable target against hostile anti-aircraft gunfire. Strange as it may seem, it was the synchronizing gear of Fokker's that caused the Allied flying units to seek better protection. They were unable to get it through fire power on one plane, hence they brought several planes together so that a heavy volume of fire could be secured from the mass. Thus in the fall of 1915 the Allied airmen used the first "V" formations for mutual protection. While the formations at first were small in size, the numbers involved in a single formation grew until at the end of the war it was not unusual to see as many as 50 or 60 planes employed in a single formation by both the Germans and the Allies.

**Types of Planes.**—Combat brought out standardized types of planes although there were almost as many models as there were manufacturers.

*Fighter.*—The fighter was a sturdy, compact and rugged plane with the highest horsepower possible and the best possible speed and climb. Through all the years which followed, the characteristics of that type of plane, jet or orthodox, did not change. High-speed races with their large prizes provided incentive each year for better racing planes and provided the testing ground of future fighter planes.

*Observation Plane.*—As most of the higher ranking officers in the war saw observation work as the primary mission of the aeroplane, a large percentage of the total planes available was assigned to such tasks. Ground troops needed to know the location of the enemy in front of them and whether or not there were fieldworks, trenches or barbed wire. Early in the war the aerial observers demonstrated that they could perform such observation duties well. In addition they took photographs which showed exact details of the terrain, even paths made by new troops moving into concealed positions.

The observation plane flew unescorted. It went through the stages of a two-seater, three-seater, heavily armed with machine guns, lightly armed. It was fixed with bomb racks and soon became a general purpose plane which could be used for observation, light bombing or as a two-seater fighter. It was seldom that the pilot of an observation plane was able to rely on support from fighting planes. Normally he went in to enemy territory to get information by himself and fought his way out against enemy fighter planes and anti-aircraft artillery.

*Bomber.*—When the United States entered the war in April 1917, the status of the various types of planes was about as outlined above. Large bombs indicated the necessity for large bombing planes. However, when it was decided to start

quantity production of aeroplanes, it was indeed a problem to determine which planes should be built. There were numerous models. Even the British, French, Belgians and the Italians could not agree among themselves as to which they should recommend. The problem of engine design was equally complex. The United States decided to build its own engine, the Liberty, which could be used as a general purpose engine in observation planes, day bombers and the two-seater fighters.

At that time the Germans were far ahead in the field of bomber development. They were using night bombing against targets in England and in western France. Their heavy bombers were comparatively slow, about 90 m.p.h. as compared with the fighter's 120 m.p.h., but they could carry bomb loads of about 1,000 lb. for several hundred miles.

In the bomber class England had the Handley Page, with two engines, and Italy the Caproni with three. U.S. military leaders had already selected the de Havilland as an observation general purpose plane and had decided that the U.S. would not build any fighter planes. The difficult decision lay in selecting the type of bomber to be built. It was finally agreed that both the Handley Page and the Caproni were to be produced in the United States. Production matters, however, were further complicated by the introduction of Glenn L. Martin's two-engined bomber in 1918. A number of these planes were also built in the last days of the war.

In view of the precedent set by the aircraft industry in its tremendous output of training planes for the British, Canadian and U.S. air forces, little difficulty was anticipated in producing the bomber. It became apparent, however, that there were many unforeseen problems connected with the construction of this type of plane, for when World War I ended in 1918, the United States had produced about 4,500 DH-4s of which about 1,216 had reached France. Shipments of Handley Pages were too few in number to be of any value in the course of the hostilities.

**Tactics of Aerial Combat.**—As the number of aeroplanes increased on the European front and as armament became more powerful, it became evident that the day of individual aerial combat was over. So came the development of aerial tactics.

*The Squadron.*—The smallest administrative organization practically universally accepted for air units was the squadron. There the men were fed, their planes were repaired and maintained, sleeping accommodations were provided and the records of all men were kept. The squadron varied in size from 50 to 250, depending upon whether it was a fighter, observation or bomber squadron. It was also the smallest tactical fighting unit. Although all types of manoeuvres were utilized, the time finally came when it was obvious that the squadron must receive support in combat. There was not enough flexibility in that one organization to secure the best results. Additional squadrons seemed to be the answer.

*The Group.*—The group, made up of two, three or four squadrons, was a natural division not only for command in the observation and bomber units but also in the combat operations of the fighters. In the fighters, it was a cardinal principle to get above the opponent. When one squadron fought independently, if a flight of three planes acted as a decoy there were but two flights of three planes left to attack. With the group formation, entire squadrons could come into the combat to swing the tide of battle as necessary.

The French and the U.S. organized squadrons into groups. The British organized them into wings.

*The Wing.*—In actual practice in warfare, there was not much use for the term wing, made up of two or more groups, until Gen. William Mitchell, of the U.S., assembled about 1,500 planes for the St. Mihiel offensive in 1918. This was the largest fleet of aeroplanes ever assembled up to that time, and it was not until World War II that the figure was reached again.

The U.S. ground forces had assembled more than 500,000 men for that offensive. Mitchell planned to isolate the battlefield to deny the Germans reinforcements in men or supplies. He hit the Germans on one flank and then the other with formations of 500 planes. Then he attacked them in the rear areas where supplies and reinforcements were being brought up. It was the first employment of aeroplanes in mass.

**Changing Techniques of Combat (1916–1918).**—The hit-or-miss methods first employed in aerial combat did not last long. The Fokker plane at first gave Germany the advantage, and it was the Allies who sought safety in numbers. Then in the summer of 1916, the Allied offensive patrols began. Planes flying in "V" formations sought out the enemy. When fairly large numbers of these "V's" were used, the Germans were no match even with their better performing planes. For the first time the Allies had attained superiority in the air.

The Germans tried to regain air superiority early in 1917 by bringing out new planes with two guns firing through the propeller instead of one. In addition they had superior performance. The technique of operations was unchanged but the pendulum swung once more to the German side until by the spring of 1917 their superiority was practically unchallenged. By the summer of 1917, however, the British and French had brought out new types of fighters and once more air superiority went to the Allies.

**Tactics of Attack.**—The simplest form of air tactics in World War I was for one fighter to creep up on a slower plane from the rear, in the area of the latter's blind spot, and shoot it down. Every variation from that simple manoeuvre complicated matters. If the attack was made from an angle, the pilot had to figure his speed, the speed of his opponent, the distance between the planes and the wind direction and velocity. Under certain conditions the consideration of all these things in the sighting formula might make the pilot aim to the rear of the hostile pilot and engine in order to get a hit.

By getting above his opponent, the fighter pilot could then, by superior speed, select his own point of attack. Accordingly fighter pilots, whether operating in flight units, in squadrons or in groups, always tried to get above their opponents. The old two seater type of plane and the slow bomber did not present much of a problem to the fighter.

## MILITARY AVIATION, 1918–1939

The period following World War I was used by practically all nations to determine the practical value of the aeroplane. The war had brought out the fact that although it was faster than any other means of travel and could be used for destroying other planes and for securing information for the ground forces as a weapon of destruction its value was extremely limited. In the United States, Gen. William Mitchell had long contended that air power was superior to sea power. In 1921 he conducted bombing tests on captured German warships. A submarine, destroyer, cruiser and battleship were bombed and sunk with a few well-placed 1,000-lb. bombs. In later tests, held in 1923, Mitchell's bombers, flying at 10,000 ft., sank the old battleships "Virginia" and "New Jersey" with 2,000-lb. bombs. The bomber had become a part of the air team.

During the period when Mitchell directed the operations of the U.S. army air corps, a flight was made from Mineola, L.I., N.Y., to Alaska and back under command of Capt. St. Clair Street in July 1920. Other outstanding flights showed the capabilities of modern aircraft. The first refuelling flight was conducted by Lieut. L. H. Smith and Lieut. J. P. Richter at Rockwell field, Calif., in Aug. 1923. Successive transatlantic flights showed that the ocean had ceased to be a military barrier to large planes. On May 2–3, 1923, Lieut. Oakley Kelly and Lieut. John Macready flew the T-2, a plane built by Anthony Fokker, former German plane manufacturer, nonstop from New York to San Diego, Calif. Although equipped with a single Liberty engine, it could carry a useful load of 3,000 pounds in addition to about eight men.

The U.S. navy kept pace with the army improvements in military planes. In the early days of flying the navy took the normal aeroplane and equipped it with floats. Then the flying boat came into the picture in 1916. The hulls were so heavy that for a while, at least, the flying boat was not very efficient. However the impetus of World War I brought out the NC type.

Naval planes followed the course of the army planes in development and construction only with the more complicated problem

tacked by 1,500 heavy bombers with eight groups of fighter bombers bombing and strafing the area for 15 min. before the heavies' attack that lasted for an hour, and with seven groups of fighter bombers going over the area from low level for 30 min. afterward. Immediately following that attack, all the light and medium bombers of the 9th bomber command wound up the operation with both area and pin-point attacks.

The U.S. infantry advanced and breached the enemy positions west of St. Lô, and freed Gen. George Patton's armour to push deeper into German-held territory. The enemy did not stand successfully again until France and Belgium had been liberated and the west wall reached.

Once Patton's 3rd army was out in the open his armoured divisions always had an escort of fighter bombers. When the 1st army joined the 3rd army near Argentan and trapped about 57,000 Germans, the 11th tactical air command of the 9th air force came in to hasten the surrender. In one day the 11th T.A.C. destroyed from 400 to 500 enemy vehicles.

**The Italian Campaign.**—In Italy the Allied air forces' efforts to assist the progress of the ground forces were successful, but not so spectacularly so as they were in France. In spite of their best efforts, the Allies were unable to stop completely the flow of essential supplies to the Germans in Italy. Nevertheless, when the ground positions in Italy stabilized following the Anzio landing in Jan. 1944, and an attempted flanking assault failed, it was thought that air attack could diminish the enemy's ability to supply, reinforce and shift his forces, and would thus so weaken him that he could neither withstand determined ground attack nor withdraw in good order.

Medium and fighter bombers attacked key bridges on the few rail lines from northern Italy to the front. From March 24 to the fall of Rome on June 4 two principal choke lines were maintained across the narrow boot. No through trains were able to run from the Po valley to the front lines, and south of Florence nearly all supplies had to be moved by truck. The enemy attempted to increase the use of shipping, but heavy bombers attacked the vessels. The Germans diverted trucks to hauling supplies around the broken bridges and, eventually, all the way from Florence to Rimini, but fighter strafing forced the trucks to operate only at night.

Germany's ability to transport supplies was reduced from an estimated 80,000 tons a day to not more than 4,000. When the Allied drive began in early May, the enemy's transport was unable to meet the demands on it. The German lines broke under the impact of the ground offensive. Retreat in good order was impossible because of the breakdown of transportation under the constant air attack.

**Industrial Collapse in Germany.**—Once Allied troops were securely established in France the campaign against the German chemical industry began in strength. By the end of 1944 the output of aviation gasoline was cut 90%, and from December on, German war production ran downhill rapidly. A month later railroad carloadings were off 75% and steel was being produced at only 20% of capacity. The strategic air war was practically over. In March the chief of German armament production, Albert Speer, knew that the third reich was finished. "The German economy," he reported, "is heading for inevitable collapse within 4–8 weeks." After Germany's surrender on May 8, Allied interrogators asked Speer if he believed strategic bombardment alone could have won the war. Speer replied: "Yes, the attacks on the chemical industry alone [synthetic oil] would have sufficed without the impact of purely military events."

## WAR IN THE PACIFIC

In making its decisive contribution to the victory in Europe the U.S. air force alone dropped a far greater tonnage of bombs than it dropped during the war in the Pacific. The Japanese were defeated before the U.S. bombing effort reached its peak. From 1943 onward, the United States enjoyed air superiority in the Pacific, and exploited it so thoroughly that World War II ended with the unconditional surrender of Japan while its armies, which had never been defeated in large scale fighting, held nearly 3,000,000 sq.mi. of southeastern Asia and dominated the lives of 500,000,000 people.

The collapse of Japan vindicated the whole strategic concept of the offensive phase of the Pacific war. In the simplest terms, that strategy called for the advance of air power, both land based and carrier based, step by step to the point where it could bring destructive power to bear directly on the Japanese homeland. When such a point was reached it was a certainty that air power would make invasion of the Japanese home islands possible. As it turned out, air power and sea power were so effective in combination that no invasion was necessary.

**Allied Air Offensive.**—On Jan. 24, 1942, the 10th air force began operations from around Chungking, in Yunnan province, China. Its first combat unit, the 23rd fighter group, had been organized from the American Volunteer group—the famous Flying Tigers. The job of the 10th at that time was to knock out Japanese airports and shoot down enemy planes, dive-bombing gunboats, junks and barges. When B-25s came to the 10th in the summer of 1942 they went after enemy shipping, docks, air bases, supply depots and troop concentrations.

In New Guinea the 5th air force was carrying out much the same sort of an operation. A year after Pearl Harbor the 5th was equipped with 81 heavy bombers, 83 medium bombers and 238 fighters. With this small force the 5th performed miracles, working out solutions to the problems posed by long overwater flying, high mountains, extensive jungle and bad weather.

In the summer of 1942, following the remarkable U.S. naval victory at Midway where four Japanese carriers were sunk, three battleships were damaged, a heavy cruiser was sunk and a number of lighter vessels were sunk or damaged, U.S. troops on Guadalcanal and Tulagi were getting air support from the 13th air force based on Espiritu Santo. At the other end of the Pacific the 11th air force had more to fight than the Japanese. In Alaska and the Aleutians, where it was based, the weather was a constant and implacable enemy. Lubricating oil congealed, tires froze to the ground; rain, snow and fog followed each other in rapid succession. Instrument flying was the usual practice in an area where mountains rose to great heights, and islands rose straight from the surface of the sea like mountain peaks. Dutch Harbor, in the Aleutians, was attacked by Japanese bombers on June 3, 1942. Air force and navy flyers had found a Japanese task force less than an hour's flying to the southeast, with two carriers, two cruisers and eight destroyers. In spite of the fact that the weather reduced visibility nearly to zero U.S. aircraft sank one of the cruisers and damaged another. Less than two weeks later aerial photographs showed Japanese on Attu, Agattu and Kiska. Their installations were bombed continually by the 11th during the next 11 months, and when U.S. surface forces finally drove them off, they didn't realize they had accomplished their mission until aerial photographs, interpreted in the United States, showed that the Japanese positions had been abandoned.

By June 1943 the tide was beginning to turn in the Pacific. On Feb. 9, 1943, Guadalcanal had fallen to U.S. forces, and on March 1–4, in the Bismarck sea action, the 5th air force and the Royal Australian air force had virtually wiped out a large Japanese convoy and its supplies, as well as nearly a division of troops, proceeding from Rabaul to Lae.

The primary objective of the Allied forces in the southwest Pacific was to advance a network of air bases deep into the Japanese perimeter. On June 30, Allied land, sea and air forces moved against the Japanese in the Solomons-New Guinea area in a simultaneous, three-pointed assault, and U.S. forces occupied Rendova Island in New Georgia. On Sept. 13 Salamaua fell to the Allies, and three days later Lae, which the Japanese had held since Jan. 1942, was recaptured. Meanwhile, the 5th air force carried out heavy attacks on Wewak and prepared Salamaua for recapture by hitting it, on July 27, with one of the heaviest bomb loads ever dropped in the southwest Pacific up to that time.

On Sept. 18–20, 1943, units of the 7th air force and two navy carrier task forces attacked Tarawa, Makin, Apamama and Nauru. The following week the 5th air force returned to Wewak, and as October began, a naval task force including six aircraft carriers

bombed Wake Island, dropping 320 tons of bombs and causing serious damage. With resistance in the central Solomons ended, the 5th air force began a series of devastating attacks on the great Japanese naval base at Rabaul on Oct. 12 that were to continue on into November.

The Japanese perimeter fell inward again when U.S. troops landed on Makin Island without opposition on Nov. 20, and simultaneously more U.S. troops established themselves successfully on Tarawa in a bloody action. In preparation for both of these attacks B-24s of the 7th air force bombed defense positions.

**The B-29 Superfortress.**—Meanwhile the plans division of air force headquarters in Washington, D.C., was giving a great deal of thought to how a new air weapon, to be available for operational use sometime in June 1944, should be employed. The new weapon was the B-29 which had been on the drawing boards in 1939. Germany was not considered as a B-29 target because the B-17s and B-24s in England would be hitting their full stride at the time the B-29s would be ready, and had all the range they needed to finish the task even though their bomb capacity was far less. On the other hand, Japan itself would remain free from bombardment for a long time unless the B-29s got into operation against it.

China was an obvious place to base the new Superfortresses, but there were no suitable airports closer than Chengtu or Chungking. The Marianas—specifically Guam, Tinian and Saipan—were selected as bases for up to 1,000 B-29s. Unfortunately, despite excellent progress in the Pacific, the Allies were a long way from the Marianas at the beginning of 1944. Hence, it was decided to get the Superfortresses into action from Chinese bases despite the difficulties of supply and the distance to Japan—2,000 mi. from Chengtu to Tokyo as compared to 1,400 or 1,500 mi. from the Marianas.

The first B-29 bombing attack occurred on June 5, 1944. Bangkok was the target and in order to hit it, the B-29s had to carry their own gasoline and bombs 1,200 mi. from Assam to Chengtu. On June 15 they hit the steel mills at Yawata and Japan was under direct, sustained attack for the first time in the war. Sasebo, Anshan, Palembang, Nagasaki and Yawata were repeatedly attacked from Chinese bases. All this, however, gave only a hint of what was to come when the Superfortresses began to operate from the Marianas.

**Invasion of the Marshalls and Marianas.**—On Feb. 7, 1944, the Japanese perimeter was again dented, this time in the Marshall Islands with the occupation of Kwajalein and Majuro. By Feb. 19, Eniwetok, westernmost of the Marshalls, had also been captured after light enemy resistance. Once on Eniwetok, U.S. forces found themselves about 2,400 mi. farther west of Pearl Harbor than they had been four months before. The Japanese inner defenses were exposed.

The question was simply where to strike next. The decision was influenced by the growing availability of B-29s and the need for bases to support further advances into the Palaus, the Philippines, Formosa and China. The joint chiefs of staff decided to by-pass Truk and strike at the southern Marianas. Truk was to be on the receiving end of a long series of neutralizing air attacks. The target date for the occupation of the Marianas was set as June 15, 1944.

Right on schedule, Saipan was attacked. During the seven days preceding the attack, heavy bombers of the 7th and 13th air forces had hit Truk to neutralize its threat to the landing operation. By July 9, organized resistance on Saipan had ended, and ten days later Guam was attacked. While the troops were moving steadily forward on Guam, Tinian was attacked on July 24. By Aug. 8 Tinian and Guam were in Allied hands.

On Nov. 24, 1944, the first B-29 mission took off from the Marianas. On that date, 100 Superfortresses left Saipan and bombed Tokyo for the first time since Gen. James Doolittle, on April 18, 1942, had taken off from the deck of the carrier "Hornet" and led 16 B-25s against Tokyo, Nagoya, Kobe and Yokohama. Within a month the B-29s had hit Tokyo three more times. They followed these attacks with one on Nagoya where they virtually demolished the Mitsubishi aircraft plant.

As 1945 began the 20th air force had a total of 345 B-29s on Guam, Tinian and Saipan and a total of 51,800 officers and men. In the five weeks of 1944 in which they had operated they had destroyed 254 Japanese aircraft and dropped 9,000 bombs.

**Bombing of Japan.**—In March 1945 Gen. Curtis LeMay, commanding officer of the 20th air force, made one of the important decisions of the war—to attack Tokyo with incendiaries at low level at night with his full force. Never before had the B-29s bombed from altitudes of less than 24,000 ft., but on the night of March 9, Tokyo was attacked by 279 B-29s at a mean bombing altitude of 7,050 ft. The Japanese defenses were confused, and only 14 B-29s were lost from all causes. About 15.8 sq.mi. of the heart of Tokyo were burned out in what was, prior to the use of atomic bombs on Aug. 5 and 8, the most destructive air attack in history. The Tokyo attack was followed by devastating night incendiary attacks on Nagoya, Kobe and Osaka in quick succession.

By the war's end, the incendiary attacks had dropped 100,000 tons of bombs in the course of 15,000 sorties against 66 Japanese cities. The United States strategic bombing survey, after an exhaustive on-the-spot study of industrial facilities following V-J day, found that aerial bombardment had cut the Japanese productive capacity, as compared to its preattack output, tremendously. Oil refineries suffered a cut of 83%; aircraft engine plants, 75%; airframes, 60%; electronics and communication, 70%; army ordnance plants, 30%; naval ordnance plants, 28%; merchant and naval shipyards, 15%; light metals, 35%; ingot steel, 15%; and chemicals, 10%.

Coupled with the decisive strategic bombing of Japan was the blockade of the home islands. Since early in the war the Japanese merchant fleet had been a primary target of Allied sea, air, and submarine forces. To the submarines of the U.S. navy goes the chief credit for reducing the Japanese merchant fleet to the point where, on V-J day, that fleet consisted of about 300 ships—a little more than 1,000,000 gross tons, or 20% of the shipping afloat when the war began. In addition, aircraft sank more than 1,000,000 tons of shipping in 1944, and despite the growing scarcity of targets continued this rate until the end of the war, when the sea-air blockade was, to all intents and purposes, complete.

The B-29s made a major contribution to this achievement. One wing of the 20th air force was trained in aerial mining operations, and during the four days prior to D-day on Okinawa dropped more than 1,000 tons of mines in the Shimonoseki straits, closing the Inland sea to all large vessels for ten days to two weeks.

(H. H. Ar.; X.)

**AIRWAY,** an artery of a mine, along which the ventilation is conducted. The districts branching from the fresh air "intakes" are ventilated by "splits" taken off the main airway. The current conducted along the branch or district intakes, round the "working face," returns by the district "return airway," enters the main "return airway" and proceeds thence to the upcast shaft up which it is drawn to the surface by fans. This is the practice in coal mining in Great Britain. In France the ventilation is generally carried out by compression, that is by fans forcing the air down the "downcast" shaft and through the workings to the "upcast."

The position, number and arrangement of the airways in an ideal coal mine are shown in the figure overleaf, as well as the manner in which the air is split for district ventilation. (*See* also Coal and Coal Mining.) *See* diagram overleaf. (R. R.)

**AIRY, SIR GEORGE BIDDELL** (1801–1892), British astronomer royal, was born at Alnwick on July 27, 1801. He was educated at Colchester grammar school and at Trinity college, Cambridge, where he graduated as senior wrangler in 1823. He became a fellow of his college (1824), Lucasian professor of mathematics (1826), and then (1828) Plumian professor of astronomy and director of the new Cambridge observatory. Before long a mural circle was installed, and regular observations were instituted with it in 1833. In the same year the duke of Northumberland presented the Cambridge observatory with a fine object-glass of 12 in. aperture, which was mounted according to Airy's designs and under his superintendence, although the erection was not completed until after his removal to Greenwich in 1835. Airy's writings during this time are divided between mathematical physics and astronomy. The former were for the most part concerned

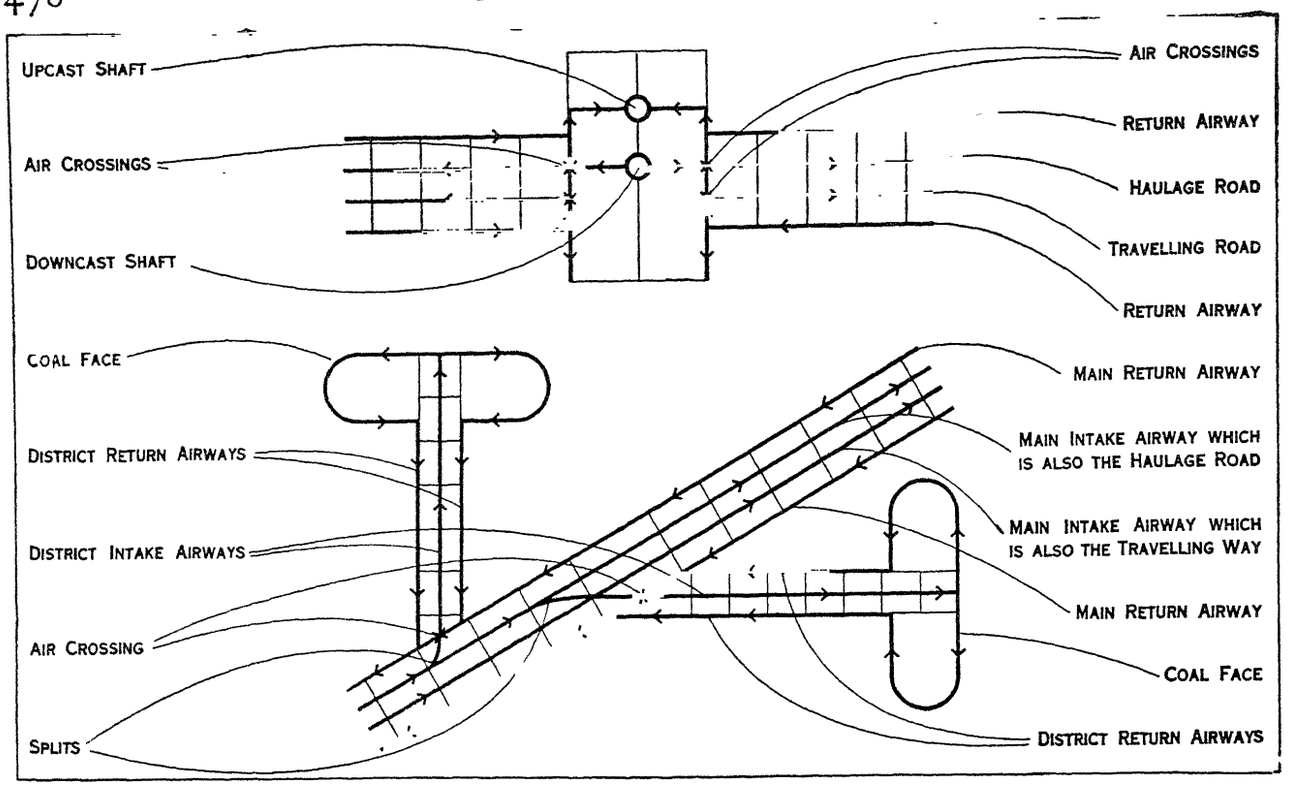



DIAGRAM ILLUSTRATING THE INSTALLATION OF AIRWAYS AND VENTILATING CURRENTS IN MINES—(SEE PAGE 477)

The upper plan shows the shaft pillars and the position of the main airways in the neighbourhood. The lower plan shows the main and district airways. The arrows in both plans indicate the direction of inward and outward air currents which make up the system of ventilation below ground

with questions relating to the theory of light, arising out of his professorial lectures, among which may be specially mentioned his paper "On the Diffraction of an Object-Glass with Circular Aperture." Of his astronomical writings during this period the most important are his investigation of the mass of Jupiter, his report to the British Association on the progress of astronomy during the 19th century, and his memoir *On an Inequality of Long Period in the Motions of the Earth and Venus.*

Airy's discovery of a new inequality in the motions of Venus and the earth was a remarkable achievement. In correcting the elements of Delambre's solar tables he discovered an inequality overlooked by their constructor. Eight times the mean motion of Venus is so nearly equal to 13 times that of the earth that the difference amounts to only the $\frac{1}{240}$th of the earth's mean motion, and from the fact that the term depending on this difference, although very small in itself, receives in the integration of the differential equations a multiplier of about 2,200,000, Airy was led to infer the existence of a sensible inequality extending over 240 years (*Phil. Trans.*, cxxii. 67). The investigation leading to this result was probably the most laborious that had been made up to Airy's time in planetary theory, and represented the first specific improvement in the solar tables effected in England since the establishment of the theory of gravitation.

In June, 1835, Airy was appointed astronomer royal in succession to John Pond. Under Airy's administration modern apparatus was installed, and the whole organization placed on a scientific footing. No fewer than 8,000 lunar observations were rescued from oblivion, and were, in 1846, placed at the disposal of astronomers in such a form that they could be used directly for comparison with the theory and for the improvement of the tables of the moon's motion. (*See* HANSEN, PETER ANDREAS.)

One of the most remarkable of Airy's researches was his determination of the mean density of the earth. In 1826 the idea occurred to him of attacking this problem by means of pendulum experiments at the top and bottom of a deep mine. After some failures, successful experiments were made at the Harton pit, near South Shields, in 1854. Their immediate result was to show that gravity at the bottom of the mine exceeded that at the top by $\frac{1}{19,286}$th of its amount, the depth being 1,256ft. From this Airy was led to the final value of 6·566 for the mean density of the earth as compared with that of water (*Phil. Trans.* cxlvi. 342). At the age of 71 Airy embarked on a new method of treating lunar theory. A general description of his method will be found in the *Monthly Notices of the Royal Astronomical Society,* Vol. xxxiv. No. 3. It consisted essentially in the adoption of Delauny's final numerical expressions for longitude, latitude and parallax, with a symbolic term attached to each number, the value of which was to be determined by substitution in the equations of motion. The work was published in 1886, when its author was 85 years of age. In 1881 Sir George Airy resigned the office of astronomer royal and resided at the White house, Greenwich, not far from the Royal observatory, until his death, which took place on Jan. 2, 1892. The learned societies of his own and other countries conferred many honours on him.

BIBLIOGRAPHY.—A list of Airy's papers will be found in his *Autobiography,* edited in 1896 by his son, Wilfrid Airy, B.A., M. Inst. C.E. *See* also his *Mathematical Tracts* (1826) *on the Lunar Theory, Figure of the Earth, Precession and Nutation,* and *Calculus of Variations,* to which, in the second edition (of 1828), were added tracts on the Planetary Theory and the Undulatory Theory of Light; *Experiments on Iron-built Ships, instituted for the purpose of discovering a correction for the deviation of the Compass produced by the Iron of the Ships* (1839); *On the Theoretical Explanation of an apparent new Polarity in Light* (1840); *Tides and Waves* (1842).

**AISLABIE, JOHN** (1670–1742), English politician, born Dec. 7, 1670. He was made chancellor of the Exchequer in 1718, and supported the proposal of the South Sea Company to pay off the national debt. At the collapse of the company he was imprisoned in the Tower with other politicians accused of attempting to profit fraudulently from the scheme, but was soon released, through Walpole's intervention.

**AISLE,** in architecture, a term primarily meaning the wing of a house, but more commonly used to indicate any long, narrow space separated from the remainder of the building by a line of piers, columns or arches. It is specially used to designate the lateral portions of a church or other large room in which interior supports occur. The term also has come to mean a passageway,

specially a passageway between groups of seats, as in a church or theatre. From the time of the early Christian basilica, the use of one or more side aisles flanking a central nave has been almost universal in church building, and church aisles are known as nave aisles, transept aisles or choir aisles from their position in relation to the nave, transept or choir. The choir aisle around the east end of a choir is known as an ambulatory (*q.v.*). In the normal Romanesque or Gothic church the roof of the aisles is lower than the central nave; but in certain examples in southern France (*e.g.*, St. Nazaire, Carcassonne), in Spain (*e.g.*, Barcelona), and especially in Germany, where for the smaller churches it is almost normal, the nave and aisles are of the same height. A church with nave flanked by one aisle on each side is known as a three-aisle church; one with two side aisles on each side as a five-aisle church, and so on.

**AISNE,** department, northern France, west of Ardennes (*q.v.*). Area 2,868 sq.mi. Pop. (1946) 453,411. It touches the western end of the Ardennes (930 ft.) in the northeast, but its surface is all of secondary or tertiary rocks. The outlying masses of the latter, often with steep flanks, form important sites such as that of Laon, the capital, and the famous Chemin des Dames. The Aisne enters the department from the east just as it leaves the chalk scarp and flows west to the Oise, the other river of the department. It has been made to stretch down to include the deep Château-Thierry portion of the Marne valley, too far west to focus on Épernay or Reims and allied to the hill country farther north rather than to Paris on the west. The department was the scene of much of World War I. It had a number of forests, but it lacks metallic ores, though quarries yield building stone, gypsum and clay. Mostly in the belt of rainfall 600–800 mm., and well watered and sheltered, it has had great farming prosperity, with specialization in dairying towards the northeast. Of the towns, Guise in the north does agricultural and other engineering and St. Quentin and numerous villages do weaving of cotton, wool and silk. St. Gobain has made mirrors since the 17th century. Sugar has been an important crop and industry. Communications are good by rail and by navigable rivers (Aisne, Oise, Marne). St. Quentin, Vervins, Laon and Soissons give their names to arrondissements and are, with Château-Thierry and Hirson (*qq.v.*), the chief towns. This department and that of Oise were rich in architectural monuments several of which were ruined in World War I, but the churches at Laon, Braine and Urcel (mainly 12th century) survived and the splendid *Basilique* of St. Quentin was largely repaired, while the castle-ruin (1400) of La Ferté-Milon did not suffer. Soissons is the seat of a bishop in the province of Reims, the court of appeal is that of Amiens (Somme), also the centre of the 2nd army corps. The department belongs to the educational province (*académie*) of Douai.

**Aisne, Battle of the, 1918.**—This title is one of several alternatives used to designate the third great German offensive of 1918, launched on May 27, against the Chemin des Dames ridge and rapidly carried across the Aisne and southward to the Marne. It is described under CHEMIN-DES-DAMES, BATTLE OF THE, 1918.

**AÏSSÉ** (a corruption of HAÏDÉE), MADEMOISELLE (*c.* 1694–1733), French letter-writer, was the daughter of a Circassian chief, and was born about 1694. Her father's palace was pillaged by the Turks, and as a child of four years old she was sold to the comte de Ferriol, the French ambassador at Constantinople. She was brought up in Paris by Ferriol's sister-in-law with her own sons, MM. D'Argental and Pont de Veyle. Her great beauty and romantic history made her the fashion, and she attracted the notice of the regent, Philip, duke of Orleans, whose offers she had the strength of mind to refuse. She formed a deep and lasting attachment to the Chevalier d'Aydie, by whom she had a daughter. She died in Paris on March 13, 1733. Her letters to her friend Madame Calandrini contain much interesting information with regard to contemporary celebrities, especially on Mme. du Deffand and Mme. de Tencin, but they are above all of interest in the picture they afford of the writer's own tenderness and fidelity.

Her *Lettres* were edited by Voltaire (1787), by J. Ravenel, with a notice by Sainte-Beuve (1846) and by Eugène Asse (1873). Mlle. Aïssé has been the subject of three plays: by A. de Lavergne and P. Foucher (1854), by Louis Bouilhet (1872) and by Dejoux (1898). *See* also Courteault, *Une Idylle au XVIIIe siècle, Mlle. Aïssé et le Chevalier d'Aydie* (Mâcon, 1900). There is an interesting essay by Sir E. Gosse in his *French Profiles* (1905).

**AISTULF** (d. 756), king of the Lombards (749–56). His first act as king was to drive the Greeks from the exarchate of Ravenna and to occupy the city, thus placing his army within striking distance of Rome. Pope Stephen II was forced to appeal to Pepin, king of the Franks, to defend the city, and in the campaigns of 755 and 756 Aistulf was defeated. The future of both the papacy and of the Lombard kingdom rested on Pepin's victory. The papacy was saved from becoming merely subordinate to the Lombard rule, and the Lombards were eventually (774) conquered by the Franks, who remained permanently hostile.

**AITKEN, ROBERT GRANT** (1864–1951), U.S. astronomer, was born in Jackson, Calif., on Dec. 31, 1864. Aitken was educated at Williams college, Williamstown, Mass., from which he graduated in 1887 and received his M.A. in 1892. In 1888–91 he was instructor of mathematics in Livermore college, and 1891–95 was professor of mathematics and astronomy in the University of the Pacific. In 1895 he was appointed astronomer at Lick observatory, Mt. Hamilton, Calif., of which he was director 1930–35. Here he specialized in the study of double stars, of which he discovered more than 3,000. For these discoveries, he was awarded in 1906 the Lalande prize by the Academy of Sciences of France and, in 1932, the gold medal of the Royal Astronomiçal society. He published *Binary Stars* (1918) and *New General Catalogue of Double Stars* (1932). He died Oct. 29, 1951.

**AITON, WILLIAM** (1731–93), Scottish botanist, was born near Hamilton in 1731, and died on Feb. 2, 1793. As director of Kew Gardens (1759–93) he effected many improvements, and in 1789 he published *Hortus Kewensis,* a catalogue of the plants there cultivated. A second and enlarged edition of the *Hortus* was brought out in 1810–13 by his eldest son, WILLIAM TOWNSEND AITON (1766–1849), who succeeded him at Kew.

**AITZEMA, LIEUWE (LEO) VAN** (1600–1669), Dutch historian and statesman, was born at Doccum, in Friesland, Nov. 19, 1600, and died at The Hague, Feb. 23, 1669. His most important work was the *Saken van Staet in Oorlogh in ende omtrent de Vereenigt Nederlanden* (1655–71), embracing the period from 1621 to 1668. It contains a large number of state documents, and is an invaluable authority on one of the most eventful periods of Dutch history. Four continuations of the history, by the poet and historian Lambert van den Bos, were published. The *Derde Vervolg Zijnde het vierde Stuck van het Vervolgh op de Historie,* etc., brought the history down to 1697.

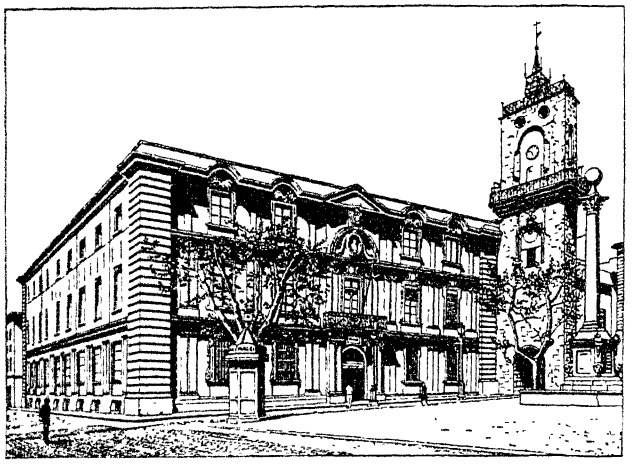
**AIVALI,** Turkey: *see* AYVALIK.

**AIX,** city of southeast France, capital of an arrondissement in the department of Bouches-du-Rhône, 18 mi. N. of Marseille. Pop. (1946) 46,053. It is situated in a plain overlooking the Arc, about a mile from the right bank of the river. Aix (*Aquae Sextiae*) was founded in 123 B.C., by the Roman consul Sextius Calvinus. In 102 B.C. Marius defeated the Cimbri and Teutones there. In the 4th century it was the metropolis of Narbonensis Secunda. Occupied by Visigoths in 477, and repeatedly plundered by Franks and Lombards, it was taken by Saracens in 731. During the middle ages it was the capital of the county of Provence and reached its zenith after the 12th century, when the houses of Aragon and Anjou made it an artistic centre and seat of learning. It passed with Provence to the crown in 1487, and had the parlement of Provence (1501–1789). In the 17th and 18th centuries it was the seat of the *intendance* of Provence.

The Cours Mirabeau divides the town into the new town to the south and the old town to the north. Aix is the seat of the faculties of law and letters of the University of Aix-Marseille. The cathedral of St. Sauveur dates from the 11th, 12th and 13th centuries. It has a rich Gothic portal with elaborately carved doors. The archbishop's palace and a Romanesque cloister adjoin the cathedral on its south side. The church of St. Jean de Malte (13th century), contains valuable pictures. The *hôtel de ville* (17th century) contains fine wood-work and a large library

with valuable mss. Aix has thermal springs, remarkable for their heat and containing lime and carbonic acid; baths have been built (1705) near the site of the Roman baths. The industries include flour-milling, the making of confectionery, the manufacture of hats and the preparation of olive-oil. Trade is in olive-oil, almonds and flour.

The town, which is the seat of an archbishop and court of appeal and the centre of an *académie,* has a court of assizes, tribunal of commerce, and a chamber of arts and manufactures. It also has museums of antiquities, natural history and painting, and several learned societies.



THE SQUARE IN AIX SHOWING THE COURT HOUSE AND CLOCK TOWER

**Aix, Battle of** (Aquae Sextiae).—After the Roman disaster at Arausio (*q.v.*) in 105 B.C. the great migration of the Cimbri and Teutones turned aside to Spain, thus enabling Marius (*q.v.*) to gain breathing space to organize and train his "new model" army. But in 102 B.C., returning to Gaul, these tribes moved to invade Italy, the Cimbri going round the north of the Alpine barrier and the Teutones by the Mediterranean coast. On their approach Marius entrenched himself and refused to be drawn out to battle, content to repulse their assault and to acclimatize his men to the sight and ways of their strange and terrifying foe. When the host passed onwards, Marius cautiously followed until on reaching Aquae Sextiae, now Aix, 20m. N. of Marseille, a partial engagement was brought on by the common desire to gain possession of the only available water supply. The Romans were successful and after a two days' pause, Marius judged the moment ripe for battle, having detached a force of 3,000 men to take up a concealed position on the enemy's flank. His cavalry and light infantry were then used to draw out the Teutones to attack, which Marius awaited on the slope of a hill. This first onslaught was stopped with difficulty, but gradually the Romans pressed their assailants downhill. Before the Teutones could reform on the level, they were struck in rear by the flank detachment, and their very numbers then intensified the press and their difficulty. The disaster was so complete that not merely the menace but the tribe itself was dispersed.

*See* Henry Bordeaux, *La Vallé d'Aix* (1921); M. A. E. Clerc, *Aquae Sextiae* (1916).

**AIX-LA-CHAPELLE:** *see* AACHEN.

**AIX-LA-CHAPELLE, CONGRESSES OF.** Three congresses have met at Aix-la-Chapelle—in 1668, in 1748 and in 1818.

1. The treaty of May 2, 1668, which ended the War of Devolution, was the outcome of that of St. Germain signed on April 15 by France and the representatives of the Triple Alliance. The Treaty of Aix-la-Chapelle left to France all the conquests made in Flanders during 1667, with all their *"appartenances, dépendances et annexes,"* a vague provision of which, after the peace of Nimwegen (1680), Louis XIV. took advantage to occupy villages and towns adjudged to him by his *Chambres de réunion* as dependencies of the cities and territories acquired in 1668. On the other hand, France restored to Spain Cambrai, Aire and Saint-Omer, as well as Franche Comté. The Treaty of Aix-la-Chapelle was placed under the guarantee of Great Britain, Sweden and Holland, by a convention signed at The Hague on May 7, 1669, to which Spain acceded.

*See* Jean du Mont, baron de Carlscroon, *Corps universel diplomatique* (Amsterdam, 1726–31).

2. On April 24, 1748, a congress assembled at Aix-la-Chapelle to end the War of Austrian Succession. The definitive treaty was signed on Oct. 18. Its most important provisions were those stipulating for (1) a general restitution of conquests, including Cape Breton to France, Madras to England and the barrier towns to the Dutch; (2) the assignment to Don Philip of the duchies of Parma, Piacenza and Guastalla; (3) the restoration of the duke of Modena and the republic of Genoa to their former positions; (4) the renewal in favour of Great Britain of the Asiento contract of March 16, 1713, and of the right to send an annual vessel to the Spanish colonies; (5) the renewal of the article of the treaty of 1718 recognizing the Protestant succession in the English throne; (6) the recognition of the emperor Francis and the confirmation of the pragmatic sanction, *i.e.,* of the right of Maria Theresa to the Hapsburg succession; (7) the guarantee to Prussia of the duchy of Silesia and the county of Glatz.

Spain having raised objections to the Asiento clauses, the Treaty of Aix-la-Chapelle was supplemented by that of Madrid (Oct. 5, 1750), by which Great Britain surrendered her claims for a sum of £100,000.

*See* Comte G. de Garden, *Hist. des traités de paix,* iii. p. 373 (1848–87).

3. The congress or conference of Aix-la-Chapelle in 1818 was primarily a meeting of the four Allied Powers—Great Britain, Austria, Prussia and Russia—to decide the question of the withdrawal of the army of occupation from France and the consequent international relationships of the Powers. The congress, which opened on Oct. 1, was attended by Alexander I. of Russia, Francis I. of Austria, and Frederick William III. of Prussia, in person. Great Britain was represented by Lord Castlereagh and the duke of Wellington, Austria by Prince Metternich, Russia by Counts Capo d'Istria and Nesselrode, Prussia by Prince Hardenberg and Count Bernstorff. The duc de Richelieu, by favour of the allies, was present on behalf of France. The evacuation of France was agreed to in principle at the first session, the consequent treaty being signed on Oct. 9. The rest of the time of the congress was mainly occupied in discussing the form to be taken by the European alliance, and the precautions to be adopted against a fresh outburst on the part of France. The proposal of Alexander I., to establish a "universal union of guarantee" on the broad basis of the Holy Alliance, broke down on the opposition of Great Britain; and the main outcome of the congress was the signature, on Nov. 15, of two instruments: (1) a secret protocol confirming and renewing the Quadruple Alliance established by the treaties of Chaumont and Paris (Nov. 20, 1815) against France; (2) a public "declaration" of the intention of the Powers to maintain their intimate union, of which the object was to preserve peace on the basis of respect for treaties. The secret protocol was communicated in confidence to Richelieu; to the declaration France was invited publicly to adhere.

The congress also concerned itself with the questions of the suppression of the slave trade and the Barbary pirates. In neither case was any decision arrived at, owing (1) to the refusal of the other Powers to agree with the British proposal for a reciprocal right of search on the high seas; (2) to the objection of Great Britain to international action, which would have involved the presence of a Russian squadron in the Mediterranean. A great variety of lesser questions was considered, but an attempt to introduce the subject of the Spanish colonies was defeated by the opposition of Great Britain. The congress represents the highest point reached in the attempt to govern Europe by an international committee of the Powers.

*See* W. Alison Phillips, *The Confederation of Europe* (2nd. ed. 1919).

(W. A. P.)

**AIX-LES-BAINS,** thermal spa and fashionable resort, east France, in the department of Savoie, near the Lac du Bourget, 9 mi. by rail N. of Chambéry. Pop. (1936) 8,917. The sulphur springs were known as *Aquae Gratianae* by the Ro[illegible]

neighbourhood has numerous ancient remains. Over 50,000 visitors are ordinarily attracted annually; the main season is July–September, but Aix also serves as a base for Alpine winter sports.

**AIYAR, SIR SHESHADRI** (1845–1901), Indian statesman, the son of a Brahman of Palghat, Malabar, rose from a humble position as translator in his native district to be prime minister of Mysore under the Maharaja Chamarajendra. To him Mysore owes many important public works and the development of the Kolar gold-fields. Aiyar retired in 1900 and died on Sept. 13, 1901.

**AIYAR, SIR TIRUVARUR MUTUSWAMY** (1832–1895), native Indian judge of the high court of Madras, was born of poor parents in the village of Vuchuwadi, near Tanjore, on Jan. 28, 1832. His widowed mother was forced by poverty to remove with Mutuswamy and his brother to Tiruvarar, where the former learnt Tamil, and soon set to work under the village accountant at a monthly salary of one rupee. Aiyar worked his way through a series of minor offices until he was able to take his degree in law. He then became a judge of the Madras small causes court, and in 1878 he was raised to the bench of the high court, which office he occupied with ability and distinction for over fifteen years, sometimes acting as the chief justice. He attended by invitation of the viceroy the imperial assemblage at Delhi in 1877. In 1878 he received the honour of C.I.E. and in 1893 the K.C.I.E. was conferred on him. He died suddenly in 1895. Aiyar took his full share in the affairs of the Madras university, of which he was nominated a fellow in 1872 and a syndic in 1877, and was well acquainted with English law, literature and philosophy. He was through life a staunch Brahman, devout and amiable in character, with a taste for the ancient music of India and the study of the Vedas and other departments of Sanskrit literature.

**AJACCIO,** capital of Corsica, on the west coast of the island. Pop. (1936) 34,393. Ajaccio occupies a sheltered position at the foot of wooded hills on the north shore of the Gulf of Ajaccio. The harbour, to the east, is protected on the south by a peninsula which carries the citadel. It is deep enough to shelter large ships. To the southwest of the peninsula lies the Place Bonaparte, frequented by winter visitors attracted by the mild climate. Apart from one or two fine thoroughfares, the streets are narrow. The present town of Ajaccio lies about 2 mi. south of its original site, from which it was transferred by the Genoese in 1492. Occupied in 1553 by the French, it again fell to the Genoese after the treaty of Cateau Cambrésis in 1559. The town finally passed to the French in 1768. Since 1810 it has been the capital of the department of Corsica. The associations of Napoleon I with the town are everywhere emphasized by street-names and statues. The town is the seat of a bishopric (7th century) and of a prefect. It has tribunals of first instance and of commerce and a museum. Ajaccio makes cigars and macaroni and carries on shipbuilding, sardine-fishing and coral-fishing. Its exports include timber, oranges, citrons and skins.

**AJAIGARH,** an Indian state in the Central India states. It has an area of 788 sq.mi., and a population in 1941 of 96,596. The ruler, who is a Bundela Rajput, bears the title of sawai maharaja and has a salute of eleven guns. He resides at Ajaigarh, at the foot of the hill-fortress from which the state takes its name. This fort is situated on a very steep hill, more than 800 ft. above the town, and contains the ruins of temples with elaborate sculptures.

**AJANTA** (more properly Ājūnthā), a village in the dominions of the Nizam of Hyderabad in India, celebrated for its cave hermitages and halls, in a wooded and rugged ravine about 3½m. from the village. The ravine is that of the river Wâgura which falls from the east over a bluff forming several waterfalls. The caves, about 30 in number, are excavated in the south side of the precipitous bank of the ravine, and are of two kinds—dwelling-halls and meeting-halls. The former have a broad verandah, its roof supported by pillars, and giving towards the interior on to a hall averaging in size about 35ft. by 20ft. Dormitories are excavated opening on to this hall, and an image of the Buddha usually stands in a niche facing the entrance. In the larger caves pillars support the roof on all three sides, forming a sort of cloister running round the hall. The meeting-halls which back into the roel-about twice as far as the dwelling-halls, were used as chapteio houses for the meetings of the Buddhist Order. The oldest caves date from 200 B.C. to A.D. 200, the next belong approximately to the 6th, and the youngest to the 7th century A.D. Most of the interior walls of the caves are covered with fresco paintings, of considerable merit, and somewhat in the early Italian style. When first discovered, in 1817, these frescoes were in a fair state of preservation, but they fell later into decay. The remains are now properly preserved, and form, with copies of those destroyed, important evidence as to pre-Hindu art in India. Ajanta was a kind of college monastery.

**AJAX** (I.) *the Greater* Gr. Aἴας, son of Telamon, king of Salamis. In Homer's *Iliad* he is described as of great stature and colossal frame, second only to Achilles in strength and bravery. He engaged Hector in single combat and, with the aid of Athene, rescued the body of Achilles from the hands of the Trojans. In the competition between him and Odysseus for the armour of Achilles, Agamemnon, at the instigation of Athene, awarded the prize to Odysseus. This so enraged Ajax that it caused his death (*Odyssey,* xi. 541). According to a later and more definite story, accepted by Sophocles as the basis of his drama, his disappointment drove him mad; he rushed out of his tent and fell upon the flocks of sheep in the camp under the impression that they were the Greeks; on coming to his senses he slew himself with the sword which he had received as a present from Hector. From his blood sprang a red flower (*see* HYACINTHUS) which bore on its leaves the initial letters of his name AI, also expressive of lament (Pausanias i. 35. 4.). He was the tutelary hero of the island of Salamis, where he had a temple and an image, and where a festival called *Aianteia* was celebrated in his honour (Pausanias i. 35).

II., *the Lesser,* son of Oïleus, king of Locris, called the "lesser" or Locrian Ajax, to distinguish him from the son of Telamon. In spite of his small stature, he held his own amongst the other heroes before Troy; he was brave, next to Achilles in swiftness of foot, and famous for throwing the spear. But he was boastful, arrogant, and quarrelsome. Athena wrecked his ship on his homeward voyage (*Odyssey,* iv. 499), presumably for his crime (not definitely mentioned by Homer) in dragging Cassandra from the statue of the goddess, during the sack of Troy, and violating her. This led to the thousand years' penance of his people; nevertheless, he was worshipped as a national hero by the Opuntian Locrians (on whose coins he appeared), who always left a vacant place for him in their battle line.

*See* articles in Roscher's *Lexikon* and Pauly-Wissowa, *Realencyklopädie;* L. R. Farnell, *Hero-Cults,* pp. 293 *et seq.* and 305 *et seq.*

**AJMERE** or **AJMER,** a city of India in Rajputana, which gives its name to a district and also to a petty province called Ajmere-Merwara. Pop. of the city (1941) 147,258. It is on the lower slopes of Taragarh Hill, in the Aravalli mountains. To the north of the city is a large artificial lake called the Ana Sagar, and farther up the valley is a new lake, the Foy Sagar, from which the water supply of the place is now derived.

The chief object of interest is the *darga,* or tomb of the famous Mohammedan saint Muin-ud-din Chishti. It is situated at the foot of the Taragarh hill, and consists of a block of white marble buildings without much pretension to architectural beauty. To this place the emperor Akbar, with his empress, performed a pilgrimage on foot from Agra in accordance with the terms of a vow he had made when praying for a son. An ancient Jain temple converted about A.D. 1200 into a mosque, is situated on the lower slope of the Taragarh hill. With the exception of that part used as a mosque, nearly the whole of the ancient temple has fallen into ruins, but the relics are not excelled in beauty of architecture and sculpture by any remains of Hindu art. Forty columns support the roof, but no two are alike, and great fertility of invention is manifested in the execution of the ornaments. The summit of Taragarh hill, overhanging Ajmere, is crowned by a fort, the lofty thick battlements of which run along its brow and enclose the tableland. The walls are 2m. in circumference, and the fort can only be approached by steep and very roughly paved planes,

the fort and the outworks, and by the hill to the was founded about the year A.D. 145 by Ajaipal, a established the dynasty which continued to rule the with many vicissitudes of fortune) while the repeated of Mohammedan invasion swept over India, until it eventu- became an appanage of the crown of Delhi in 1193. Its internal government, however, was handed over to its ancient rulers upon the payment of a heavy tribute to the conquerors. It then remained feudatory to Delhi till 1365, when it was captured by the ruler of Mewar. Akbar took it back in 1556; and it continued in the hands of the Moguls, with occasional revolts, till 1770, when it was ceded to the Mahrattas, from which time up to 1818 the unhappy district was the scene of a continual struggle, being seized at different times by the Mewar and Marwar rajas, from whom it was so often retaken by the Mahrattas. In 1818 the latter ceded it to the British in return for a payment of 50,000 rupees.

The modern city is an important administrative and railway centre. It is well laid out with wide streets and handsome houses. The city does an active trade in salt which is imported in large quantities from the Sambar lake and Ramsur. Oil making is also a profitable branch of trade. Cotton cloths are manufactured to some extent, for the dyeing of which the city has attained a high reputation. The educational institutions include the Mayo Rajkumar college, opened in 1875, for training the sons of the nobles of Rajputana, on the lines of an English public school.

Seven miles from Ajmere lies the lake of Pushkar, one of the most sacred pieces of water in India, where a pilgrim fair is held every autumn, and Brahma has the only temple dedicated to him in India.

The district of Ajmere, which forms the largest part of the province of Ajmere-Merwara, has an area of 2,125 sq.mi. Population 378,960, inclusive of Ajmere city. Besides the city of Ajmere, the district contains the military station of Nasirabad, with a population of 32,196 (1941).

**AJMERE-MERWARA,** a former British district of India, in Rajputana agency, consisting of the two districts of Ajmere and Merwara, separated from each other and isolated amid Indian states. Pop. (1941) 583,693. The administration was in the hands of a commissioner, subordinate to the governor general's agent for Rajputana. The capital is Ajmere city. The area is 2,400 sq.mi. The Aravalli range is the distinguishing feature of the district. The range of hills which runs between Ajmere and Nasirabad marks the watershed of the subcontinent of India. The rain which falls on one side drains into the Chambal, and so into the Bay of Bengal; that which falls on the other side, into the Luni, which discharges itself into the Runn of Cutch. The province is on the border of what may be called the arid zone; it is the debatable land between the northeastern and southwestern monsoons, and beyond the influence of either. The southwest monsoon sweeps up the Nerbudda valley from Bombay and crossing the tableland at Neemuch gives copious supplies to Malwa, Jhalawar and Kotah and the countries which lie in the course of the Chambal river; but it is only when the monsoon is in considerable force that Merwara gets a plentiful supply from it. The northeastern monsoon sweeps up the valley of the Ganges from the Bay of Bengal and waters the northern part of Rajputana, but hardly penetrates farther west than the longitude of Ajmere. The agriculturist in Ajmere-Merwara can thus rarely rely upon two good harvests in succession. A district subject to such conditions can hardly be free from famine or scarcity for any length of time, but the population, having declined in the period from 1891–1921, showed a steady increase after 1921. Among Hindus, the Rajputs are landholders, and the Jats and Gujars are cultivators. The Jains are traders and moneylenders. The aboriginal tribe of Mers are divided between Hindus and Mohammedans. The chief crops are millet, wheat, cotton and oil seeds. There are several factories for ginning and pressing cotton, the chief trading centres being Beawar and Kekri.

**AJO,** an unincorporated town in Pima county, southern Arizona, U.S., about 25 mi. from the Mexican border and 90 mi. southwest of Phoenix; the altitude is 1,859 ft. It is on state highway 85 and is served by the Tucson, Cornelia and Gila Bend railroad. The population was 5,777 by the federal census of 1950. There are copper, gold, silver and lead mines in Ajo, and copper is smelted there. Spaniards were working the copper mines at Ajo as early as 1750. In 1854 the Ajo Copper company became the first incorporated mining company in the territory. After mining, the ore was hauled across the desert and shipped via the Gulf of California to Swansea, Wales, for smelting.

Originally, the town was called Muy Vavi, a Papago Indian term for warm water, but later it was changed to Ajo, Spanish for garlic, which grows plentifully in the nearby hills.

**AJODHYA,** an ancient city of India, situated on the right bank of the Gogra, in the Fyzabad district of the United Provinces. In remote antiquity Ajodhya was one of the largest and most magnificent of Indian cities. It is said to have covered an area of 96 sq.mi., and was the capital of the kingdom of Kosala, the court of the great king Dasaratha, who was the father of Rama, the hero of the *Ramayana.* The opening passages of that epic recount the magnificence of the city, the glories of the monarch and the virtues, wealth and loyalty of his people. A period of Buddhist supremacy followed the death of the last king of the Solar dynasty. On the revival of Brahmanism, Ajodhya was restored by King Vikramaditya (*c.* 57 B.C.). Kosala has claims to be the birthplace of the founders of both Buddhism and Jainism. The Chinese traveller, Hsüan Tsang, in the 7th century, found 20 Buddhist temples with 3,000 monks at Ajodhya, among a large Brahmanical population. The ancient city is now represented by a heap of ruins, with a few fine temples, and the modern town is only a small suburb of Fyzabad.

**AKA HILLS,** a tract of country on the northeast frontier of India, occupied by an independent tribe called the Akas. It lies north of the Darrang district of eastern Bengal and Assam, and is bounded on the east by the Dafla Hills and on the west by independent Bhutia tribes. The Aka country is very difficult of access, the direct road from the plains leading along the precipitous channel of the Bhareli river, which divides the Aka from the Dafla country.

The Akas are a brave people, and the men are strong and well made. They have clans graded socially, a dual organization and burial of the dead. They worship the Bhareli river annually, poison their arrows with aconite and play both varieties of nose flute.

The reputation of the Akas as raiders is sufficiently shown in the division of the tribe into two clans, the Hazari-khoas or "eaters of a thousand hearths," and the Kapah-chors or "thieves that lurk in the cotton fields." In the early years of British occupation, about 1829, they gave much trouble; and in 1883 they broke out once more into their old habits. They raided into the British district of Darrang and carried off several native forest officers as hostages. An expedition was sent against them under Gen. Sale Hill with 860 troops, which was completely successful. Living among them as a labouring but not servile class is the Niggiya or Khoa tribe divided into four clans.

*See* Nevill, "The Akas," *Assam Census Report,* 1921, I, App. B, i.

**AKALKOT,** a native state of India, in the Deccan and Kolhapur agency. It forms part of the Deccan tableland, and has a cool climate. Area 473 sq.mi.; pop. (1931) 92,605; (1941) 103,903. The tribute is £1,000. The state was under British management.

The town of Akalkot is situated near the Great Indian peninsula railway, which traverses the state. Pop. (1941) 13,810.

**AKAN,** a Gold Coast tribe inhabiting the Koforidua district of the Accra hinterland, neighbours of the Fanti and Ashanti, with whom they probably share a common origin, their language being closely related to these two idioms, and their organization being the same.

*See* Sarbah, *Fanti Customary Law* (1904).

**AKBAR, JALAL UD-DIN MOHAMMED** (1542–1605), the greatest of the Mogul (Mughal) emperors of India, was born at Umarkot in Sind when his father Humayun, who had been driven from the throne of Delhi by an Afghan usurper named Sher Shah, was escaping to Persia. Thirteen years passed before Humayun felt strong enough to attempt the reconquest of Hindustan,

and little had been accomplished before his death in 1556: in fact there was no Mogul empire before Akbar, but only the attempt to create one. Akbar's first task on his succession to the throne was to overthrow all rival claimants, the chief of them being the usurping Hindu minister Hemu whose forces were routed at Panipat on Nov. 5, 1556. By 1562 Akbar's kingdom embraced the Punjab and Multan; the basin of the Ganges and Jumna from Panipat to Allahabad, Gwalior in central India, Ajmere in Rajputana and the province of Kabul in Afghanistan. Another 14 years of almost incessant warfare resulted in the conquest of Malwa, Chitor, Ranthambhor, Kalinjar, Gujarat and Bengal. Thus, by 1576, Akbar was master of almost the whole of northern India. Between 1586 and 1595 he added Kashmir, Sind, Baluchistan, Kandahar and parts of Orissa to his dominions. With his power firmly established in the north he crossed the Narbada into the Deccan and annexed Khandesh, Berar and parts of Ahmednagar. At his death in 1605 his empire comprised 15 *subas* (provinces) and stretched from the Hindu Kush to the Godavari and from Bengal to Gujarat.

Akbar was endowed with a genius for administration to which the structure of both his central and provincial governments bears testimony. He deliberately accepted compromise as the basis of his empire and by his policy of *sulh-i-kull* (universal toleration) sought to conciliate the subject Hindu population and secure their loyalty. Realizing that it was impossible to govern as a strictly orthodox Moslem monarch, he abolished the hated *jizya* or poll-tax on non-Moslems and the tax previously levied on Hindu pilgrims. Hindus, especially Rajputs, were given important posts in the army and in the revenue department. To relieve the pressure on the peasants he demanded no more than one-third of their gross produce as land revenue. But although his interest in religious toleration was genuine his policy appears to have been dictated rather by political and dynastic considerations: his conception of sovereignty was autocratic and his religious policy an assertion of the supremacy of the state, politically, economically and financially. For this reason he crushed the power of the *ulema*, a body of orthodox divines and doctors of the law who constituted a check upon his power, by forcing them to subscribe to a document known as the Infallibility decree which assigned to Akbar the rank of *mujtahid* (interpreter) thus making him the authority on all matters relating to Islam.

Although illiterate Akbar was extremely interested in the study of comparative religion and built an *ibadat khana* or "house of worship" where learned men of all religions discussed theological problems. As a result of these discussions he became convinced that there was good in all religions and went so far as to promulgate a new eclectic faith called the *Din Illahi*. At his request three separate Jesuit missions were sent to his court; but they failed to convert him to Christianity as he was unable to give up the pleasures of the harem or subscribe to the doctrines of the Trinity and the Incarnation. The departure of his successors from the main principles of his rule, especially their policy of religious intolerance, paved the way for the decline of the Mogul empire.

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**AKCHA,** a town and khanate of Afghan Turkistan, 42 mi. W. of Balkh on the road to Andkhui. It is protected by a mud wall and a citadel. Estimated population 8,000, chiefly Uzbegs. The khanate is small, but well watered and populous. The rivers which rise in the southern mountains end near Akcha in vast swamps filled in flood time with débris of hillside plants.

**AKEE,** the West African name of a small tree (*Blighia sapida*) of the soapberry family (Sapindaceae), native to Guinea, and also of its important food fruit. Introduced in 1778 into Jamaica, which now exports the fruit, its cultivation has spread throughout most of tropical America. The shrublike, stiff-branched tree, sometimes 20 ft. to 30 ft. high, bears handsome red or orange coloured fruits, about 3 in. long, in small clusters at the tips of slender branches. The fruit, which is a soft-walled capsule, splits when ripe into three sections, from apex to base, displaying round, shining, black seeds, attached to the base by large whitish or yellowish fleshy arils. When cooked the arils bear a resemblance to a fine omelette both in taste and in appearance; the Latin-American name *seso vegetal* (vegetable brain) is significant of their form.

**AKEN,** a town of Germany on the Elbe in the south-east of the district of Magdeburg, Prussian Saxony. Pop. (1939) 12,490. Chemicals and oils are manufactured. There is considerable transit trade on the Elbe, and petrol storage.

**AKENSIDE, MARK** (1721–1770), English poet and physician, was born at Newcastle-on-Tyne. He was the son of a butcher, and was slightly lame all his life from a wound he received as a child from his father's cleaver. He was sent (1739) to Edinburgh to study theology with a view to becoming a minister, but in fact studied medicine, and seems to have drifted to a mild deism. His politics, says Dr. Johnson, were characterized by an "impetuous eagerness to subvert and confound, with very little care what shall be established," and he is caricatured in the republican doctor of Smollett's *Peregrine Pickle*. He was elected a member of the Medical Society of Edinburgh in 1740. His ambitions already lay outside his profession, and his gifts as a speaker made him hope one day to enter parliament. In 1740 he printed his "Ode on the Winter Solstice" in a small volume of poems. In 1741 he left Edinburgh for Newcastle and began to call himself a surgeon, though it is doubtful whether he practised, and from the next year dates his life-long friendship with Jeremiah Dyson (1722–1776). During a visit to Morpeth in 1738 he had conceived the idea of his didactic poem, *The Pleasures of the Imagination*. He had already acquired a considerable literary reputation when he came to London about the end of 1743, and offered the work to Dodsley for £120. Dodsley thought the price exhorbitant, and only accepted the terms after submitting the manuscript to Pope, who assured him that this was "no everyday writer." The three books of this poem appeared in Jan. 1744. It was translated eventually into German, French and Italian, and gained a general success. His aim, Akenside tells us in the preface, was "not so much to give formal precepts, or enter into the way of direct argumentation, as, by exhibiting the most engaging prospects of nature, to enlarge and harmonize the imagination, and by that means insensibly dispose the minds of men to a similar taste and habit of thinking in religion, morals and civil life." Akenside's powers fell short of this lofty design; his imagination was not brilliant enough to surmount the difficulties inherent in a poem dealing so largely with abstractions; but the work was well received by the general public. His success was not unchallenged. Gray wrote to Thomas Wharton that it was "above the middling," but "often obscure and unintelligible and too much infected with the Hutchinson jargon." The reference was to Francis Hutcheson (1694–1746), author of an *Inquiry into the Original of our Ideas of Beauty and Virtue* (1725).

Into a note added by Akenside to the passage in the third book dealing with ridicule, William Warburton chose to read a reflection on himself. Accordingly he attacked the author of the *Pleasures of the Imagination*—which was published anonymously—in a scathing preface to his *Remarks on Several Occasional Reflections, in answer to Dr Middleton* . . . (1744). This was answered, nominally by Dyson, in *An Epistle to the Rev. Mr Warburton*, in which Akenside no doubt had a hand. It was in the press when he left England in 1744 to secure a medical degree at Leyden. In little more than a month he had completed the necessary dissertation, *De ortu et incremento foetus humani*, and received his diploma. Returning to England he attempted without success to establish a practice in Northampton. In 1744 he published his *Epistle to Curio*, attacking William Pulteney (afterward earl of Bath) for having abandoned his liberal principles to become a supporter of the government, and in the next year he produced a small volume of *Odes on Several Subjects*, in the preface to which he lays claim to correctness and a careful study of the best models. His friend Dyson had meanwhile left the bar, and had become, by purchase, clerk to the house of commons. Akenside had come to London and was trying to make a practice at Hampstead. Dyson took a house there, and did all he could to further his friend's interest in the neighbourhood. But Akenside's arrogance and pedantry frus-

trated these efforts, and Dyson then took a house for him in Bloomsbury Square, making him independent of his profession by an allowance stated to have been £300 a year, but probably greater, for it was asserted that his income enabled him to "keep a chariot," and to live "incomparably well." In 1746 he wrote his much-praised "Hymn to the Naiads," and he also became a contributor to Dodsley's *Museum, or Literary and Historical Register.*

He was now 25 years old, and began to devote himself almost exclusively to his profession. He was an acute and learned physician. He was admitted M.D. at Cambridge in 1753, fellow of the Royal College of Physicians in 1754, and fourth censor in 1755. In June 1755 he read the Gulstonian lectures before the college, in Sept. 1756 the Croonian lectures and in 1759 the Harveian oration. In Jan. 1759 he was appointed assistant physician, and two months later principal physician to Christ's hospital, but he was charged with harsh treatment of the poorer patients, and his unsympathetic character prevented the success to which his undeniable learning and ability entitled him. At the accession of George III, both Dyson and Akenside changed their political opinions, and Akenside's conversion to Tory principles was rewarded by the appointment of physician to the queen. Dyson became secretary to the treasury, lord of the treasury, and in 1774 privy councillor and cofferer to the household.

Akenside died on June 23, 1770, at his house in Burlington street, where the last ten years of his life had been spent. His friendship with Dyson puts his character in the most amiable light. Writing to his friend so early as 1744, Akenside said that the intimacy had "the force of an additional conscience, of a new principle of religion," and there seems to have been no break in their affection. He left all his effects and his literary remains to Dyson, who issued an edition of his poems in 1772. This included the revised version of the *Pleasures of Imagination,* on which the author was engaged at his death.

*See* Dyce's *Life of Akenside* prefixed to his edition of the *Poetical Works* (1835); also Johnson's *Lives of the Poets,* and C. Bucke, *Life, Writings and Genius of Akenside* (1832).

**AKERMAN, JOHN YONGE** (1806–1873), English antiquarian, distinguished chiefly in numismatics, was born in Wiltshire. He became early known in connection with his favourite study, having initiated the *Numismatic Journal* in 1836. In the following year he became secretary of the newly established Numismatic society. In 1848 he was elected secretary to the Society of Antiquaries, an office which he was compelled to resign in 1860 on account of failing health. Akerman published a considerable number of works on his special subject, the more important being a *Catalogue of Roman Coins* (1839); a *Numismatic Manual* (1840); *Roman Coins Relating to Britain* (1844); *Ancient Coins —Hispania, Gallia, Britannia* (1846); and *Numismatic Illustrations of the New Testament* (1846). He also wrote a *Glossary of Words Used in Wiltshire* (1842); *Wiltshire Tales, Illustrative of the Dialect* (1853); and *Remains of Pagan Saxondom* (1855).

**AKHALTSIKH** (Georgian *Akhaltsikhe*="New Castle"), a town in the Georgian S.S.R. It is situated in 41° 40′ N. and 42° 55′ E. at an altitude of 3,375 ft. on a tributary of the Kura river. The new town is on the right bank, the old on the left. Pop. about 15,000. Capital of the former province of Meschia or Samtskhe, it appears as a fief of the feudal house of Jaqeli *c.* 1203. By the 13th century, the Jaqelis acquired the whole principality of Meschia with the title of Atabegs (hence another name of the province: Saatabago). The separatist tendencies of Meschia first manifested in 1268 came to a break with the crown of Georgia under the Atabeg Quarquare II, who was referred to in the west as "duke of Akhaltsikhe" or "of Georgiana," in 1463. But in the 16th century the principality became tributary to the Ottoman empire. In 1625 the Atabeg Beka III turned Moslem and was created by the sultan pasha of Akhaltsikhe, which rank was borne by the rulers of Meschia until the Turkish suppression of this vassal principality in 1744. In 1828 Akhaltsikhe was taken by the Russians and the whole province incorporated in the Russian empire. There is trade in silk, honey and wax. Brown coal is found in the district. Its silver filigree work is famous. It is on the trade route to Turkey for caravans, but it has no railway communications. (*See* GEORGIA.)

**AKHENATON:** *see* IKHNATON.

**AK-HISSAR** or AKHISAR (anc. THYATEIRA, the "town of Thya"), a Turkish town situated in a fertile plain on the Gürdük Chai (Lycus), in the Manisa vilayet, 58 mi. N.E. of Smyrna. Pop. 22,739. Thyateira was an ancient town re-peopled with Macedonians by Seleucus about 290 B.C. It became an important station on the Roman road from Pergamum to Laodicea, and one of the "Seven Churches" of Asia (Rev. ii, 18), but was never a *metropolis* or honoured with a neocorate, though made the centre of a *conventus* by Caracalla. The modern town is connected with Smyrna by railway, and exports cotton, wool, opium, cocoons and cereals. Cotton of excellent quality is grown in the neighbourhood, and the place is celebrated for its scarlet dyes.

*See* W. M. Ramsay, *Letters to the Seven Churches* (1904); M. Clerc, *De rebus Thyatirenorum* (1893).

**AKHMIM,** a town of upper Egypt, on the right bank of the Nile, 67 mi. by river south of Asyut, and 4 mi. above Suhag, on the opposite side of the river. It has several mosques and two Coptic churches, maintains a weekly market, and manufactures cotton goods, notably the blue shirts and check shawls with silk fringes worn by the poorer classes of Egypt. Outside the walls are the scanty ruins of two ancient temples. In Abulfeda's days (13th century A.D.) a very imposing temple still stood here. Akhmim was the Egyptian Apu or Khen-min, in Coptic Shmin, known to the Greeks as Chemmis or Panopolis, capital of the 9th or Chemmite nome of upper Egypt. Herodotus mentions the temple dedicated to "Perseus" and asserts that Chemmis was remarkable for the celebration of games in honour of that hero, after the manner of the Greeks, at which prizes were given; but it is possible that he confused Coptos (*q.v.*) with Chemmis. Strabo mentions linen weaving as an ancient industry of Panopolis, and it is not altogether a coincidence that the cemetery of Akhmim is one of the chief sources of the beautiful textiles of Roman and Coptic age that are brought from Egypt. Monasteries abounded in this neighbourhood from a very early date. Nonnus, the Greek poet, was born at Panopolis.

**AKHTAL** (ahch-tahl′) (GHIYATH IBN HARITH) (*c.* 640–710), Arabian poet of the Omayyad period, belonged to the tribe of Taghlib in Mesopotamia, and was, like his fellow tribesmen, a Christian, enjoying the freedom of his religion, while not taking its duty very seriously. Akhtal, Jarir and Ferazdaq form a trio celebrated among the Arabs, but as to relative superiority there is dispute. Abu 'Ubaida placed him highest of the three on the ground that among his poems there were ten flawless *qasîdas* ("elegies"), and ten more which were nearly so, and that this could not be said of the other two poets.

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A full account of the poet and his times is given in H. Lammens' *Le chantre des Omiades* (Paris, 1895) (a reprint from the journal *Asiatique* for 1894).

**AKHTYRKA,** a town in the Ukrainian S.S.R. It is situated in 50° 20′ N. and 34° 52′ E. near the Vorskla river, on the railway from Kiev to Kharkov. Its beautiful cathedral, built in 1753, was designed by Rastrelli. It is a trade centre for fruit, sugar beet, corn, cattle and domestic woollen industries. It was founded by Poles in 1642. Population (1935) 27,302.

**AKKA** (TIKKI-TIKKI), a race of African pygmies first seen by the traveller G. A. Schweinfurth in 1870, in the Mangbettu country, northwest of Albert Nyanza. The home of the Akka is the dense forest zone of the Aruwimi district of the Congo state. They form a branch of the primitive pygmy Negroid race, and appear to be divided into groups, each with its own chief. The average height of the race would seem to be somewhat under four feet. They are of the colour of coffee slightly roasted, with hair almost the same colour, woolly and tufted; they have very projecting jaws, flat noses and protruding lips. An abdominal protuberance makes all Akka look like potbellied children, and the spine hollows into a curve like an **S.** These characteristics tend to disap-

pear. There is a tendency to steatopygia among the women. They are nomads, hunt game in the forests with poisoned arrows, with pitfalls and springs set everywhere, and with traps. They collect ivory and honey, manufacture poison, and exchange these for cereals, tobacco and iron weapons. In dress, weapons and utensils they are as the surrounding Negroes. They build round huts of branches and leaves in the forest clearings.

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**AKKAD,** an ancient country (for the town sometimes called Akkad *see* under AGADE), northern Babylonia. The alluvial part of Mesopotamia was known in ancient times as Sumer and Akkad. Akkad was the narrow strip of land where the rivers approached one another most closely, and included the cities of Kish, Babylon, Sippar, Borsippa, Cutha (*qq.v.*) and Opis. For details *see* MESOPOTAMIA: *Ancient Geography.*

**AKKADIAN:** *see* ACCADIAN.

**AKKERMAN,** Rumania: *see* CETATEA ALBA.

**AKMOLINSK,** a town and province of the Kazakh Soviet S.R. The boundaries of the province are, north, northern Kazakstan; east, Pavlodar; south, Karaganda; west, Kustanaisk province. In the north the province is dotted with salt lakes, sloping south to a plateau (1,600 ft.), to the east of which is a spur formed by the dying out of the Tarbagatai range containing gold, copper and coal.

The Spasski copper mines are in the province and were restarted in 1925; near them are the Karagandinask coal beds, estimated at 6,000,000,000 tons; the two are connected by rail and are linked to the main railway.

The southeast is a wide, waterless desert the Bak-pak-dala or Hunger steppe. The climate is dry and continental, the rainfall (average 8–16 in.) is mostly in heavy thunderstorms, moistening the surface only. Dry, strong northeast winds, dusty in summer, prevail all the year, in winter as the Buran gale, sweeping the snow away and exposing the ground to five months of frost.

At Akmolinsk city (average temperature January 1.5° F., July 70° F.; yearly rainfall 9 in.), south of latitude 50°, the steppe is salty soil, with sparse wormwood, blue-gray grass, and plants with drought-resisting devices, hairs, pungent oils, thick leaves, etc., and animals such as suslik, hamster, jerboa and, rarely, saiga antelope. North of latitude 50° there is more moisture and better soil; in spring it is gay with tulips, irises, etc.; and in summer with white feather grass. The southern part of this area is inhabited by Kirghiz (in the Chu valley). The nomad Kara Kirghiz rear sheep, horses, camels, cattle and goats, following the pasture.

The city had a population in 1939 of 35,800.

Near the northern boundary of the province, wheat and barley are successfully grown, and the population consists mainly of Russian peasants. The town of Akmolinsk, on the Ishim river, is on the caravan routes from Tashkent and Bukhara to the north.

**AKOLA,** a town and district of India, in Berar, otherwise known as the Hyderabad Assigned Districts. The town is on the Murna tributary of the Purna river, Akola proper being on the west bank, and Tajnapeth, containing the government buildings and European residences, on the east bank. It had a pop. (1941) of 62,564. It is walled, and has a citadel built in the early years of the 19th century. Akola is one of the chief centres of the cotton trade in Berar, and has numerous ginning factories and cotton presses. Among the educational establishments are a government high school, and an industrial school supported by a Protestant mission.

The district of Akola as reconstituted in 1905 had an area of 4,093 sq.mi., the population of this area in 1941 was 907,742. The surface of the country is generally flat, the greater part being situated in the central valley of Berar. On the north it is bounded by the Melghat hills. By the addition of Basim and Mangrul *taluks* in 1905, the district includes the eastern part of the Ajanta hills, with peaks rising to 2,000 ft., and the tableland of Basim.

North of the Ajanta hills the country is drained eastward by the Purna affluent of the Tapti and its tributaries. The heat from April to mid-June is very great but even during the hot season the nights are cool. The annual rainfall averages 34 in. In the Purna valley the soil is everywhere a rich black loam particularly suitable to cotton, and nearly the whole of the land is cultivated. The history of Akola is not distinguished from that of the other portions of Berar.

**AKRON,** a city of Ohio, U.S., 35 mi. S.-by-E. of Cleveland, on the Little Cuyahoga river; the county seat of Summit county. It is about 1,200 ft. above sea level, on one of the highest spots in the state, whence its Greek name. The surrounding country is hilly and there are 20 lakes within 12 mi. of the city. On its northern boundary the Big Cuyahoga river flows through a gorge of great beauty, spanned by High Level bridge. A main approach from the north and east is by the North Hill viaduct, 135 ft. high and 2,810 ft. in length. Akron is served by the Baltimore and Ohio, the Erie, the Pennsylvania and the Akron, Canton and Youngstown railways. A belt line encircles the industrial section and the city is an important trucking centre. There are two municipal airports, one the site of Goodyear zeppelin dock, and the city is served by American, Capital, Eastern and United airlines. A naval air station is located in Akron. The Ohio canal, abandoned by commercial traffic, supplies water to some of the industries from lakes south of the city and serves as a pleasure route to the Portage lake state park near by. The city covers 55 sq.mi. Pop. (1950) 273,189; (1940) 244,791; (1930) 255,040.

The important period in Akron's history began about 1910. The town was settled about 1825 and incorporated as a village in 1836; became the county seat in 1842 and was chartered as a city in 1865. Through the 19th century it had a normal gradual development, at first because of its position on the Ohio canal, later because of the completion of the railway which is now the Erie and still later because of the manufacture of clay products and rolled oats. The pioneer rubber factory was established by B. F. Goodrich in 1870, and others came into existence with the extension of the uses of rubber for bicycle tires, heels and soles, beltings for machinery, elastic stockings, insulated wire and many other purposes. By 1900 the population had increased to 42,728, and in 1910 it was 69,067.

Then began a phenomenal growth. Between 1910 and 1920 the population of the city tripled. The aggregate value of its manufactured products rose from $73,158,000 in 1909 to $558,962,000 in 1919 ($575,000,000 in 1950); the average number of wage earners in the factories increased from 15,831 to 65,054 (85,000 in 1950). Postal receipts were quadrupled. All this was due chiefly to the demand for tires and other rubber products by the automobile industry. Akron's rubber factories at mid-20th century were producing more than 50,000 articles, ranging from rubber bands to balloons and dirigibles, and including 65% of the total U.S. output of tires. Normally Akron rubber factories account for approximately 40% of the annual U.S. consumption of crude rubber.

The older industries (oatmeal, matches and sewer pipes, machine tools, etc.) are still important. The town produces also puffed grains for breakfast foods, chemical stoneware, porcelain insulators, fishing tackle, rubber factory equipment, steel automobile rims, automobile batteries, wood products, plasters and chemicals. Salt and sulphur are refined, and zinc oxide is produced.

The production of synthetic rubbers became a major industry during World War II. Parts for aeroplanes also are fabricated there.

The rapid industrial development stimulated progress in other directions. Expenditures by the city for health and sanitation increased from $53,231 in 1910 to $795,100 in 1950; sanitation and health from $277,454 to $9,970,498. A municipal water system and a sewage-treatment plant were provided a cost of $125,000,000 and an imposing municipal building was erected. Experts surveyed the public-school system (1917) and prepared a city plan (1919). A city planning commission created in 1920 secured the adoption of a zoning ordinance in 1922. More than 4,300 ac. of park area are in or near the city, including a fine municipal golf

course. The Portage lakes also provide excellent recreation sites. From 1920 the charitable agencies were jointly financed by a "community chest" operated by the Better Akron federation.

The University of Akron, which is a part of the free public-school system of the city, was created in 1913, when the city council accepted as a nucleus the plant and endowment of Buchtel college, which had been founded in 1870 and named after its chief benefactor, John R. Buchtel (1822–92), a businessman of Akron. Fellowships for research in the chemistry of India rubber were established by the Goodyear and the Firestone Tire and Rubber companies. At mid-20th century the annual enrolment in the university was about 4,500.

Because of the dominating industries Akron's population has tended to have a preponderance of men, a high proportion of skilled and semiskilled labour; relatively high wages; and a high proportion of men engaged in gainful occupations. The population was not congested, even after the period of rapid growth. Small detached or semidetached dwellings are the rule. At mid-20th century, approximately 70% of the homes were owned by their occupants.

A "home rule" charter went into effect Jan. 1, 1920. Under it Akron adopted the city-manager form of government, but after four years this was discarded and the executive duties were transferred to a mayor elected at large. The old Portage trail, used by the Indians in carrying their canoes from the Cuyahoga river to the Tuscarawas river in the journey from Lake Erie to the Ohio, runs through the city. It is marked at each end by commemorative tablets and bronze figures of Indians. A house once occupied by John Brown, the abolitionist, is in the western part of the city.

**AKSAKOV, SERGEI TIMOFEYEVICH** (1791–1859), Russian writer, grandson of Sergei Aksakov, a country squire who founded a colony in the Bashkir steppe, was born at Ufa, Orenburg, on Sept. 20, 1791, and died in Moscow on April 30, 1859. He studied at the University of Kazan, and in 1808 entered the civil service in St. Petersburg (Leningrad). In 1815 he married and returned to the Urals to cultivate his estate. He dissipated his fortune after ten years of estate management, and found, through the influence of Shishkov, a place in the censorship at Moscow. There his house became a centre of Slavophilism. In 1832 he met Gogol, in whom he recognized a genius unspoiled, as he thought, by foreign influence. His friendship with Gogol led him to write himself, and, though that friendship was clouded in later years, it is to Gogol that Aksakov owed his inspiration. Aksakov draws on the history of his pioneer grandfather, a great figure of the family autocrat in a primitive community, wonderfully depicted, with the marriage of his own father and mother, and with his own schooldays. All these books are Russian classics. They give a picture of Russian rural life before the liberation of the Serfs remarkable in itself, and beautiful because of the author's keen, sensuous appreciation of nature, but interesting from the purely literary point of view in the development of the novel. Aksakov, to quote Prince Mirsky, "came nearer than any other Russian writer, even than Tolstoy in *War and Peace*, to a modern, evolutionary, continuous presentation of human life, as distinct from the dramatic and incidental presentation customary to the older novelists."

His best known works are: *Chronicles of a Russian Family* (1856, tran. by M. C. Beverley, 1924); *Recollections* (1856), tran. by J. D. Duff under the title: *Autobiography of a Russian Schoolboy* (1917, repr. 1924); *Years of Childhood* (1858: tran. by J. D. Duff, 1916, repr. 1923). Aksakov's other important work is his *Recollections of Gogol*, which is the most important contemporary record of that great writer.

His elder son, KONSTANTIN SERGEYEVICH AKSAKOV (1817–1860), Slavophil author, was born at Moscow on April 10, 1817, and died in the Island of Zante in Greece on Dec. 19, 1860.

His younger son, IVAN SERGEYEVICH AKSAKOV (1823–1886), Russian Slavophil writer, was born at Nadezhdin in Ufa, on Sept. 26, 1823, and died at Moscow on Jan. 27, 1886. He studied law at St. Petersburg, and later entered the Moscow division of the senate. At various periods he edited or established weekly and daily papers, the Moscow *Sbornik*, the *Den* (1861–65), the *Moskva* (1867), which was three times suppressed by the government, and later, in 1880, the *Rus*, an organ of the Slavophil party. Between 1840 and 1860 Aksakov wrote numerous radical and political poems. His realistic poem *The Tramp* (1852), depicted the life of the Russian peasant. The height of Aksakov's activity as leader of the Panslavist movement was reached in 1876–78, when he warmly supported the cause of the liberation of the Balkan Slavs. In 1878 he was exiled from Moscow for a violent attack on the treaty of Berlin in a speech delivered at the Slavic committee; but he was soon allowed to return, and continued to publish the *Rus* until his death.

**AKSHAK,** a city in northern Sumer (now Iraq), 34° N., 44° E. There was a prehistoric Sumerian city on this site which lay on the Tigris at the mouth of the river Adhem (Physcus). It was the most northerly of the Sumerian cities and appears in the dynasty lists between Maer and the 4th dynasty of Kish. The site is usually identified with the Opis of Xenophon, who states that it was a large and populous city and that the Physcus was here spanned by a bridge, but Rawlinson identified Opis with another ancient site south of the Diyala, near Baghdad.

**AK-SHEHR** or AKSEHIR (anc. PHILOMELION), town, Konia vilayet, Turkey, at the edge of a fertile plain, on the north side of the Sultan Dagh. Philomelion was probably a Pergamenian foundation on the Graeco-Roman highway from Ephesus to the east, and to its townsmen the Smyrniotes wrote the letter that describes the martyrdom of Polycarp. Cicero, on his way to Cilicia, dated some of his extant correspondence there; and the place was important in frontier wars between Byzantine emperors and the sultanate of Rum. It became an important Seljuk town, and late in the 14th century passed into Ottoman hands. There Bayezid Yilderim is said by Ali of Yezd to have died after his defeat at Angora. The place still enjoys much repute among Turks as the burial place of Nasr-ed-din Hodja. The town has a station on the Anatolian railway, about 60 mi. from Afiun Qarahisar and 100 mi. from Konia. Pop. (1940) 12,502.

**AKSU:** *see* TURKISTAN.

**AKSUM** (previously AXUM), an ancient city in Tigré, Abyssinia, 14° 8′ N., 38° 31′ E., altitude 7,226 ft., 12 mi. W. by S. of Aduwa. The old Abyssinian Book of Aksum contains the native legend of its foundation many thousands of years ago; the first authoritative mention of it, however, is in the *Periplus Maris Erythraei* (*c.* A.D. 67) where it is referred to as the seat of the Axumite kingdom, the successor of the more ancient Punt and the forerunner of the modern Abyssinia. (*See* ETHIOPIA.)

It contains the ancient church where, according to tradition, the *Tobot* or Ark of the Covenant, brought from Jerusalem by the son of Solomon and the Queen of Sheba, was deposited and is still supposed to rest. The church was burned when Axum was sacked by Mohammed Gran the Moslem invader of Abyssinia in about 1535 and a new one was erected by the Portuguese shortly afterward. It is famous for the ancient inscriptions in Minaco Sabaean, a Gîz script of the 4th and 5th centuries and for its stone obelisks, many of which are still standing. They form a consecutive series from rude unhewn stones to highly finished obelisks, of which the tallest still erect is 60 ft. in height, with 8 ft. 7 in. extreme front width; others that are fallen may have been taller. The highly finished monoliths are all representations of a many-storied castle, with an altar at the base of each. They appear to be connected with Semitic sun-worship and are assigned by J. T. Bent to the same period as the temple at Baalbek.

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**AKTUBINSK,** formerly part of the Turgai region, now a region in the Kazakh Soviet Socialist Republic. Area 176,632.6 sq.mi. The boundaries are, on the north, Chkalov and Kustanaisk; west, Adaev and Uralsk; south, Adaev, the Aral sea and Syr-Darya; east, Akmolinsk. It is divided for administrative purposes into Aktubinsk, pop. 238,059 (urban 20,504); Temirsk, pop. 77,-

799, (urban 4,000); Turgai, pop. 94,304, (urban 1,836); Chelkarsk, pop. 90,376 (urban 6,716). South of the east to west stretch of the Ural river, the Ural mountains continue as a plateau, the southward termination of which (the Mugojar hills) is deeply dissected by the streams of the craggy southeastern slopes, a former shore line of the Aral sea. Beneath these slopes the streams lose themselves in the saline steppes that fringe the Aral sea and extend far northeast as part of the Turgai steppe. The climatic conditions are increasingly dry (av. rainfall four to eight inches), and the prevailing northeast winds bring sandstorms in summer and dry snow in winter, a season otherwise of cloudless skies and bitter cold, while the summer temperature averages 85° F. The numerous lakes are surrounded by reeds, the haunt of the wild boar, with grass patches in places; the stream shores are also grassy, especially in spring, and attract geese and cranes. The steppe includes black-earth areas carrying feather grass, clays bearing wormwood, salt clays with salsolaceae vegetation and bare shifting sand hills. Wild cherry and almond grow on the hillsides. The steppe fauna includes jerboa, marmot, steppe fox and saiga antelope. Famines are frequent for lack of irrigation and scientific crop rotation, though rye, wheat, oats, barley and potatoes are grown. Nomadic herding of sheep, horses, camels and cattle is the chief occupation, and there is change of ground between the spring-and-summer grazing area of the Turgai steppe and the winter shelters in the Syr-Darya area. Cattle and hides are exported to Orenburg and camels are bred for the caravan transport between Bukhara, Khiva and Russian Turkistan. Sunflower-seed oil, flour and leather are produced for local use and salt is obtained from the lakes, while *koustar* (home) industries in felt products and carpets are widespread. The Emba river naphtha area extends into the southwest of the region and has its centre at Emba. In the northwest, near the Ulek river, coal is mined. Aktubinsk, the chief town, is on the Chkalov-Tashkent railway.

**AKYAB,** a municipality and district in the Arakan province of Burma at the confluence of the large rivers Mayu, Kaladan and Lemro. After the cession of Arakan to the British by the treaty of Yandaboo in 1826 the old capital of Myohaung was abandoned as the seat of government, and Akyab on the sea coast selected instead. Trade restrictions were removed and Akyab rapidly grew from a small fishing village into a leading port of Burma, with a population in 1931 of 38,094 (28,724 males and 9,370 females). The population has varied but slightly after the census of 1881. Out of the total population 4,049 (3,877 males and 172 females) are "adventitious" Mohammedan and Hindu labourers. The settled civil population comprises 15,802 Buddhists (Arakanese and Burmese, 8,111 males and 7,691 females), 10,988 Hindus (10,259 males and 729 females) and 10,032 Mohammedans (9,456 males and 576 females).

It contains the usual public buildings and several large rice mills. The chief export is rice. The district lies along the northeastern shores of the Bay of Bengal, with an area of 5,176 sq.mi. and a population in 1941 of 760,705. (*See* BURMA.)

**ALA,** one of the side recesses which usually opened off the atrium (*q.v.*) of a Roman house. One was placed on each side in the corners off the back of and entirely open to the atrium. The term applies also to the wings, open their entire width in front, at each side of the cella in one of the Tuscan temple plans (Vitruvius iv, 7). In physiology, any winglike process such as one of the lateral cartilages of the nose (Lat. *ala,* a wing). In botany, one of the side petals of a papilionaceous corolla, etc.

**ALABAMA,** called the "Cotton state" because of its chief agricultural product, a southern state of the U.S.A., is situated between approximately 84° 51′ and 88° 28′ W. and 30° 13′ and 35° N., and is bounded N. by Tennessee, E. by Georgia, S. by Florida and the Gulf of Mexico, and W. by Mississippi. Its total area is 51,609 sq.mi., of which 531 are water surface.

**Physical Features.**—Northern Alabama is a diversified region, invaded by the Appalachian highlands. In the northeast Lookout, Raccoon and Sand mountains are important physical features. The rugged Cumberland plateau, extending deeply into the state from Tennessee, is crossed from east to west by the fertile Tennessee valley. The great Appalachian valley and the Piedmont plateau invade the state for a considerable distance from the Georgia line.




THE GREAT SEAL OF THE STATE OF ALABAMA, ADOPTED BY ACT OF THE LEGISLATURE AND APPROVED ON APRIL 5, 1939

The Tennessee and Coosa rivers, draining the highlands, provide an important power resource. A belt of prairie country crosses the central portion of the state from east to west, while further south lies the Gulf coastal plain, which slopes gradually down to sea level in the south, where it touches the Gulf of Mexico. The rivers of the coastal plain are the Tombigbee and Black Warrior in the west, the Alabama in the central west, and the Chattahoochee, which forms almost half of the Georgia boundary, in the east. The Tombigbee and the Alabama unite in the southwest; their waters then part to flow into Mobile bay as the Mobile and Tensas rivers. The valleys of the coastal plain are broad and in most cases rise in three successive terraces above the streams. The bay of Mobile averages about 12 ft. in depth, though there is a deep anchorage near the entrance, some 30 mi. below the city of Mobile. In 1951 a dredged channel 33 ft. deep reached from the bay entrance to the extensive port facilities of Mobile.

**Climate and Soil.**—Alabama has a temperate climate. The average mean temperature for the state in winter is 46° F. and in summer 79° F. In the winter, on the average, 35 days have temperatures below the freezing point; snow falls only once or twice a year in the northern part. The prevailing winds are from the south. Rainfall is fairly evenly distributed throughout the state, the annual average being about 52 in.; thunderstorms are numerous in summer. The rainy season is in the winter, however, and the dry season in late summer and fall.

There are four different belts of soil. In the timber belt along the coast the soil is sandy and generally poor but responds to fertilization. North of this lies the black belt ("black prairie" "cotton belt"), 13,000 sq.mi. in extent which has black soil that is rich in limestone and marl formations, without sand or loam and is especially adapted to the production of cotton and grasses. Between the cotton belt and the Tennessee valley lies the mineral belt, the soils of which are of varied fertility. North of the mineral belt is the cereal belt in the Tennessee valley, containing red clays and dark loams.

**History.**—The first Europeans to enter the limits of the present state of Alabama were Spaniards, who claimed the region as a part of Florida. The first fully authenticated visit was that of Hernando de Soto, who journeyed along the Coosa, Alabama, and Tombigbee rivers in 1539–40. The English, too, claimed the region north of the Gulf of Mexico, and the territory of modern Alabama was included in the province of Carolina by the charters of 1663 and 1665. English traders from Carolina were frequenting the valley of the Alabama river as early as 1687. Mobile, the first permanent white settlement in Alabama, was founded by the French in 1702. Later, on account of intrigues between English traders and the Indians, the French established two military posts.

The treaty of Paris, in 1763, terminated the French occupation and England came into undisputed possession of the region between the Chattahoochee and the Mississippi. The portion of Alabama below line 32° 28′ N. became a part of west Florida and the portion north of this line a part of the "Illinois country," set apart by royal proclamation for the use of the Indians. By the treaty of Versailles, on Sept. 3, 1783, England ceded West Florida to Spain; but by the treaty of Paris, signed the same day, it ceded to the United States all of this province north of 31°, and thus laid the foundation for a long controversy. By the treaty of Madrid, in 1795, Spain ceded to the United States claims to the lands east of the Mississippi between 31° and 32° 28′; and three years later (1798) this district was organized by congress as the Mississippi territory. A strip of land 12 or 14 mi. wide near the present northern boundary of Alabama and Mississippi was claimed

by South Carolina which, however, ceded this claim to the federal government in 1787.

Georgia, on the basis of its charter, claimed all the lands between the 31st and 35th parallels from its present western boundary to the Mississippi river, a claim not surrendered until 1802; two years later the boundaries of the Mississippi territory were extended to include all of the Georgia cession.

In 1813 congress annexed to the Mississippi territory the Mobile district of West Florida, claiming that it was included in the Louisiana purchase. The whole area of the present state of Alabama then for the first time became subject to the jurisdiction of the United States. In 1817 the Mississippi territory was divided; the western portion became the state of Mississippi, and the eastern the territory of Alabama, with St. Stephens, on the Tombigbee river, as the temporary seat of government. In 1819 Alabama was admitted to the union.

One of the first problems of the new commonwealth was that of finance. Since the amount of money in circulation was insufficient to meet the demands of the increasing population, a system of state banks was instituted. State bonds were issued and school land sold to secure capital. The notes of the banks, loaned on security, became a medium of exchange. Prospects of an income from the banks led the legislature of 1836 to abolish all taxation for state purposes. This was hardly done, however, before the panic of 1837 wiped out a large portion of the banks' assets; next came revelations of careless and corrupt management, and in 1843 the banks were placed in liquidation. After disposing of all their available assets, the state assumed the remaining liabilities, for which it had pledged itself.

The Indian problem was important at this time. With the encroachment of the white settlers upon their hunting grounds the Creek Indians grew restless, and the great Shawnee chief Tecumseh, who visited them in 1812, fomented their discontent. When outbreak of the War of 1812 with Britain gave the Creeks assurance of British aid, many of them rose in arms, massacred several hundred settlers who had taken refuge in Fort Mims, below the junction of the Alabama and Tombigbee rivers, and soon no white family in the Creek country was safe outside a palisade. The Chickasaw and Choctaw Indians, however, remained the faithful allies of the whites and volunteers from Georgia, South Carolina and Tennessee helped to put down the Creeks.

Gen. Andrew Jackson broke forever the power of the Creek confederacy in the battle of Horseshoe Bend. By the treaty of Fort Jackson (Aug. 9, 1814) the Creeks ceded their claims to about one-half of the present state; and further cessions by the Cherokees, Chickasaws and Choctaws left the Indians only about one-fourth of Alabama. By a series of treaties with the Indians, between 1830 and 1835, the U.S. government arranged for their removal to the west. Before the contract for the removal of the Creeks was effected, the state legislature formed their lands into counties and settlers flocked in. A disagreement ensued between Alabama and the United States authorities; although it was amicably settled, it engendered a feeling that the policy of the national government might not be in harmony with the interests of the state —a feeling which, intensified by the slavery agitation, did much to cause secession in 1861.

*Political History.*—The political history of Alabama may be divided into three periods—that prior to 1860, from 1860 to 1874, and from 1874 onward.

The first period was one of a healthy and virile political life. Until 1832 the Democratic party was the only party in the state, but about the same time the Whig party was formed chiefly in counties where slaves were most numerous and the freemen most aristocratic. For some time the Whigs were nearly as numerous as the Democrats, but they never controlled the state government. The states' rights men were in a minority; nevertheless, under their active and persistent leader, W. L. Yancey (1814–1863), they prevailed upon the Democrats in 1848 to adopt their most radical views.

During the agitation over the introduction of slavery into the territory acquired from Mexico, Yancey induced the Democratic state convention of 1848 to adopt the "Alabama platform," which declared that neither congress nor the government of a territory had the right to interfere with slavery in a territory, that those who held opposite views were not Democrats and that the Democrats of Alabama would not support a candidate for the presidency if he did not agree with them on these questions. This platform was endorsed by conventions in Florida and Virginia and by the legislatures of Georgia and Alabama. Old party lines were broken by the compromise of 1850. The states' rights men founded the Southern Rights party, which demanded the repeal of the compromise, advocated resistance to future encroachments and prepared for secession, while the Whigs, joined by the remaining Democrats, formed the party known as the "Unionists," which unwillingly accepted the compromise and denied the constitutional right of secession. The Unionists were successful in the elections of 1851 and 1852, but the feeling of uncertainty engendered in the south by the passage of the Kansas-Nebraska bill and the course of the slavery agitation after 1852 led the State Democratic convention of 1856 to revive the Alabama platform; and when the Alabama platform failed to secure the formal approval of the Democratic national convention at Charleston, South Carolina, in 1860, the Alabama delegates, followed by those of the other cotton states, withdrew. Upon the election of Abraham Lincoln, Gov. Andrew B. Moore, in obedience to previous instructions of the legislature, called a state convention on Jan. 7, 1861. After long debate it adopted on Jan. 11 an ordinance of secession, and Alabama became one of the Confederate states of America, whose government was organized at Montgomery Feb. 4, 1861. Yet many prominent men opposed secession, and in northern Alabama, where there were relatively few slaves, an attempt was made to organize a neutral state, Nickajack; but with President Lincoln's call to arms opposition to secession ended.

In the early part of the Civil War, Alabama was not the scene of military operations, yet the state contributed about 120,000 men to the Confederate service, almost all its male white population capable of bearing arms; 39 of these men attained the rank of general. In 1862 the Federal forces secured a foothold in northern Alabama. The interior of the state was subjected to several raids after 1862, and in 1865 Mobile was taken by a Federal fleet and army. Several days before the fall of Mobile, Selma was sacked by the Wilson raiders.

According to the presidential plan of reconstruction, a provisional governor for Alabama was appointed in June, 1865; a state convention met in September and declared the ordinance of secession null and void and slavery abolished; a legislature and a governor were elected in November; the legislature was at once recognized by the national government, and the inauguration of the governor-elect was permitted after the legislature had, in December, ratified the 13th amendment. But the passage by the legislature of vagrancy and apprenticeship laws designed to control the Negroes flocking from the plantations to the cities intensified the congressional hostility to the presidential plan and the Alabama senators and representatives were denied their seats in congress. In 1867 the congressional plan of reconstruction was completed and Alabama was placed under military government. Negroes were now enrolled as voters and large numbers of white citizens disfranchised. "Carpet-baggers" from the north organized the Republican party on the basis of Negro votes and the support of native whites called "scalawags." A constitutional convention controlled by the carpet-baggers met in Nov., 1867, and framed a constitution which conferred suffrage rights on Negroes and disfranchised a large class of whites. The constitution was defeated by the whites, who stayed away from the polls, thus preventing the required majority of registered voters from voting. Congress, however, provided subsequently that a majority of the votes cast should be sufficient, and thus the constitution went into effect. The state was admitted to the union in June, 1868, and a new governor and legislature were elected.

The next two years are notable for legislative extravagance and corruption. The state endorsed railway bonds at the rate of $16,000 a mile until the state debt had been increased by $17,000,000, and similar extravagance characterized local government. The native white people united, formed a conservative

party, and elected a governor and a majority of the lower house of the legislature in 1870; but, as the new administration was largely a failure, there was in 1872 a reaction in favour of the "radicals," as the Republicans were locally known. Affairs went from bad to worse. In 1874, however, the power of the radicals was finally broken and the conservative Democrats elected all state officials. A commission appointed to examine the state debt found it to be $32,000,000; by compromise it was reduced to $12,413,514. A new constitution was adopted in 1875, which gave equal civil and political rights to all citizens and forbade the state, counties and towns to engage in internal improvements or to give their credit to private enterprise.

After 1874 the Democratic party controlled the state administration. The Republicans usually did not make nominations for state office. They endorsed the tickets of the Greenback party in 1880 and 1882 and of the Populists in the 1890s. Economic distress among the farming classes found expression in the Jeffersonian Democratic party, organized in 1892. After the regular Democratic ticket was elected in that year, however, the Jeffersonians and Populists joined forces in the election of 1894. When, at the same time, the Republicans united with the Populists and Jeffersonians, the combination elected three congressional representatives and secured control of many of the counties but failed to carry the state. It was less successful in the next few campaigns. Partisanship became intense and charges of corruption of the Negro electorate were made. Consequently, after division on the subject among the Democrats themselves, as well as opposition from Republicans and Populists, a new constitution with restrictions on suffrage was adopted in 1901. The new restrictions resulted in the virtual elimination of the Negro vote and, therefore, in a reduction of the Republican vote. The Republican party, which had polled 54,737 votes in the presidential election of 1896 and 55,634 votes in the election of 1900, polled only 22,472 votes in the election of 1904. Its vote remained at about that level until 1920, when the effects of economic changes began to appear in elections. In the presidential election of that year the Republican vote was 74,690, or 31.9% of the vote cast—more than enough to secure the privilege of a primary for the nomination of candidates in the next election at the expense of the state government. The gains of the Republican party were registered chiefly in the growing industrial districts and in the counties round about, such as Chilton, De Kalb, St. Clair and Winston, in which the party polled majorities, and in Blount, Clay, Cullman, Marshall and Shelby, in which it polled strong minorities. Although its vote fell off to 45,005 in 1924, the striking increase in the Republican vote in the preceding 20 years and the appearance of a Socialist vote were considered by many the normal result of industrial development and by some as a sign of a future breakup of the "solid South."

The strength of the Republican party remained in the hill counties of the state. The threatening poll of 120,724 for Hoover in 1928 was largely the result of sectarian hostility to Smith and to his opposition to prohibition. Yet he carried the state by about 7,000 votes.

Franklin D. Roosevelt won easily in 1932 by 207,910 to 34,674; in 1936 by 238,195 to 35,358; in 1940 by 250,723 to 43,493; and in 1944 by a wide margin. In 1948 the Democratic electors, having pledged themselves not to vote for the election of Harry S. Truman, cast their votes for Gov. J. Strom Thurmond of South Carolina, running on the States' Rights Democrat ticket; Thurmond received 171,443 popular votes and Thomas E. Dewey, Republican, 40,930.

Three important amendments, pertaining to education and highways, were added to the constitution of 1901: one provided for local option by counties and school districts as to increased taxation for public schools; each of the other two (one in 1922 and the other in 1927) authorized the issue of state bonds to the amount of $35,000,000 for the construction of a complete system of highways, thus securing for the state the national appropriations in aid of that policy. The problems of the depression in the early 1930s compelled several emergency measures and permanent reforms. A special convention voted for repeal of the federal prohibition amendment; a special legislature proposed an amendment to the constitution to validate about $17,000,000 in outstanding state warrants largely held by teachers and another to provide a state income tax; both of these measures were ratified by popular vote.

The legislature of 1939 proposed amendments for the improvement of the system of pardons and paroles and for biennial sessions of the legislature, which were ratified. This same legislature enacted a state civil service law, and passed acts for the reorganization of the state government for the purpose of eliminating duplication of work and providing better administration.

**Government.**—The constitution of the state was drafted in 1819 and revised in 1865, 1868, 1875 and 1901. The revision of 1901 lengthened the term of executive and legislative officials from two to four years, made that of the judiciary six years, provided for quadrennial sessions of the legislature (changed to biennial sessions by an amendment of 1939), and introduced the office of lieutenant governor. The passage of local or special bills by the legislature was generally prohibited. A provision, intended to prevent lobbying, prohibited anyone except legislators and representatives of the press from being admitted to the floor of the house except by unanimous vote. No executive official might serve two consecutive terms (sheriffs were included in this provision until exempted by an amendment of 1939), and the governor could not be elected or appointed to the U.S. senate or to any state office during his term as governor or within one year thereafter. Sheriffs whose prisoners suffered mob violence might be impeached.

The constitution of 1901 eliminated most of the Negroes from politics by a suffrage clause which went into effect in 1903, restricting the right to vote to those who could read and write any article of the constitution of the United States and who had been regularly engaged in some lawful employment, business or occupation, trade or calling for the greater part of the 12 months preceding the time they offered to register, or who had paid taxes on property assessed at $300. But by what was called the "grandfather clause" those who had served in the army or navy of the United States or of the Confederate states in time of war, their lawful descendants in every degree, and persons of good character who understood "the duties and obligations of citizenship under a republican form of government" were relieved from the operation of this law, provided they registered prior to Dec. 20, 1902. The constitution of 1901 (like that of 1875) and special statutes enacted thereunder required separate schools for white and Negro children. A "Jim Crow" law had been enacted in 1891.

Under the constitution of 1901 no person under 45 might vote who had not by Feb. 1 preceding an election paid all poll taxes due from him to the state (constitutional amendments of 1923, 1924 and 1944 exempted veterans of World Wars I and II). The penalty for buying, selling, or offering to buy or sell a vote was disfranchisement; in 1891 the Australian ballot system was adopted.

The constitution of 1901 exempted a homestead of 80 ac. of farmland or of a house and lot not exceeding $2,000 in value from liability for any debt contracted since July 30, 1868, except for a mortgage on it to which the wife consented; personal property to the value of $1,000 was also exempted. All amendments to the constitution had to be approved by a three-fifths vote of each house of the legislature and then ratified by the people.

Under the civil code of 1897 the earnings of a wife were made her separate property, and it was provided that "no woman, nor any boy under the age of 12 years, shall be employed to work or labor in any mine in this state." By acts of 1915 and 1919 restrictions were placed upon the employment of children under 14. An amendment of 1947 provided that no child under 16 might be employed in any gainful occupation except agriculture and domestic service; no child under 16 might be employed during school hours, and no child under 16 might be employed on or near dangerous machinery or more than 40 hours per week, except in agriculture.

Any person or firm violating these provisions was subject to

fines, and the child welfare department with a local board of child welfare in each county was available to see to the enforcement of the law.

**Population.**—The population of Alabama in 1820 was 127,901; in 1860 it was 964,201; in 1900, 1,828,697; in 1940, 2,832,961; and in 1950, 3,061,743. This last figure represents an increase of 8.1% over the population in 1940. The population per square mile in 1950 was 59.9, as compared with 55.5 in 1940, and with 50.6 for the U.S. in 1950.

Of the 1950 population, 1,228,209, or 40.1%, lived in incorporated places of 2,500 or more, as compared with 30.2% in 1940, when these places constituted the urban area. The entire urban population, under a new definition set up for 1950, which included also the thickly settled suburban area, or "urban fringe," adjacent to Birmingham, Mobile and Montgomery, and nine unincorporated places of 2,500 or more outside this fringe, amounted to 1,340,937, or 43.8% of the state total.

TABLE I.—*Population of Alabama and Its Principal Cities, 1930-50*

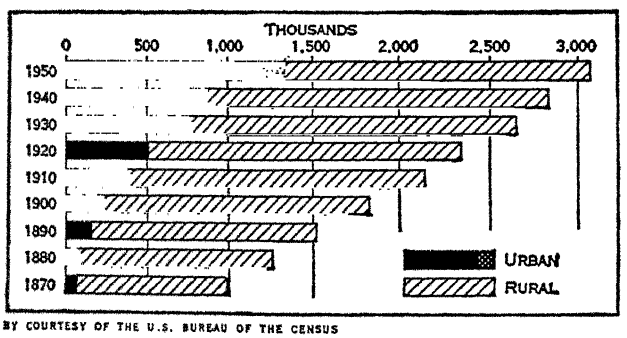
| Area | Population | | | Per cent of increase | |
|---|---|---|---|---|---|
| | 1950 | 1940 | 1930 | 1940–50 | 1930–40 |
| The state | 3,061,743 | 2,832,961 | 2,646,248 | 8.1 | 7.1 |
| Urban | 1,340,937* | 855,941 | 744,273 | 56.7 | 15.0 |
| Rural | 1,720,806* | 1,977,020 | 1,901,975 | −13.0 | 3.9 |
| Per cent urban | 43.8 | 30.2 | 28.1 | — | — |
| Principal cities | | | | | |
| Birmingham | 326,037 | 267,583 | 259,678 | 21.8 | 3.0 |
| Mobile | 129,009 | 78,720 | 68,202 | 63.9 | 15.4 |
| Montgomery | 106,525 | 78,084 | 66,079 | 36.4 | 18.2 |
| Gadsden | 55,725 | 36,975 | 24,042 | 50.7 | 53.8 |
| Tuscaloosa | 46,396 | 27,493 | 20,659 | 68.8 | 33.1 |
| Anniston | 31,066 | 25,523 | 22,345 | 21.7 | 14.2 |
| Bessemer | 28,445 | 22,826 | 20,721 | 24.6 | 10.2 |

*Final figures based on new definition. *See* comment in text.

The number of households in 1950 was 786,467, as compared with 673,815 in 1940. The average population per household had declined from 4.2 in 1940 to 3.9 in 1950.

The population of the state was distributed by colour and nativity in 1950 as follows: 67.5% native white; 0.5% foreign-born white; and 32.0% nonwhite, practically all Negro. There were 98.6 males per 100 females in the native white population, and 91.7 in the Negro population; 6.5% of the population was 65 years old or over; and 51.2% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 29.4% was engaged in agriculture, 24.2% in manufacturing and 18.5% in transportation and trade.




BY COURTESY OF THE U.S. BUREAU OF THE CENSUS

URBAN AND RURAL POPULATION OF ALABAMA: 1870 TO 1950
The crosshatched part of the 1950 bar represents the population of the additional areas counted as urban under the new 1950 definition

**Finance and Taxation.**—Formerly a large part of the state's revenue came from a general property tax, but as a result of a gradual change this source provided only 4.1% of the state government's revenue in 1949. Other principal sources in 1949 were the sales tax (18.8%), gasoline tax (17.0%), income tax (8.2%), tobacco tax (4.1%), motor vehicle licence tax (3.4%), profits from state liquor stores (6.9%) and federal grants for roads, health, schools, conservation, welfare, etc. (20.6%), the total receipts being $174,391,524.64.

TABLE II.—*State Expenditures, 1949*

| | Disbursement | Per cent of total |
|---|---|---|
| General government | $6,103,026.68 | 3.5 |
| Protection to person and property | 6,123,605.19 | 3.5 |
| Highways | 25,965,298.24 | 14.9 |
| Development and conservation of natural resources | 3,737,978.83 | 2.2 |
| Health and sanitation | 4,202,918.74 | 2.4 |
| Hospitals and institutions for the handicapped | 4,219,444.22 | 2.4 |
| Public welfare | 25,830,676.76 | 14.8 |
| Correction | 4,459,381.29 | 2.6 |
| Education | 63,853,743.13 | 36.6 |
| Libraries | 92,956.02 | 0.05 |
| Recreation | 71,400.06 | 0.04 |
| Liquor stores | 2,138,930.71 | 1.2 |
| Debt service | 3,733,086 25 | 2.1 |
| Payments to counties | 19,251,147.87 | 11.1 |
| Payments to cities | 4,520,310.89 | 2.6 |
| Total | $174,303,904.88 | 100.0 |

Figures given do not cover city and county receipts and disbursements except as indicated.

The framers of the constitution of 1901, thinking to avoid a repetition of the reckless borrowing of the reconstruction period, prohibited an increase of the state's debt for any other purpose than the suppression of rebellion or resistance to invasion, but amendments later provided for the floating of special loans for certain internal improvements.

**Education.**—Public education, authorized for Mobile alone in 1826 and inaugurated there in 1852, was extended to the whole state in 1854. Previously there had been a township system, which received support from special taxes fixed by each township and from the sale of public lands given to the state by the federal government.



BY COURTESY OF THE U.S. BUREAU OF RECLAMATION

HOME OF A NEGRO FARM TENANT

The constitution of 1875 made the support of the schools dependent upon the land grant of 1819, the poll tax and state appropriations; it established separate schools for Negroes and whites. The constitution of 1901 made obligatory a state tax of from 30 to 65 cents on each $100 worth of property to be expended on education. The legislature of 1907 voted an increase of $300,000 for the common school fund, granted state aid for rural school buildings and established a system of county high schools. A constitutional amendment in 1915 allowed the counties to levy a special school tax. In 1948–49 the state board of education disbursed $56,917,948 for elementary and secondary education and the state teachers' colleges.

Illiteracy decreased from 50% in 1880 to 34% in 1900 and 4.9% in 1949 among those between 7 and 20 years of age. In 1949 illiteracy among persons between 16 and 20 had been reduced to about 1% (white, 0.5%; Negro, 2.0%).

A school code for Alabama was framed in 1919 as a result of a report of the results of an investigation made by the U.S. bureau of education at the request of a state educational commission. Extensive revisions of the code were made by the legislature in 1927. Further extensive studies of and reports on the state's educational system were made by the Brookings institution of Washington in 1932 and by a state commission in 1945.

In 1951 education was free between the ages of 6 and 20 and compulsory between the ages of 7 and 16. The school census of 1946 counted 784,922 children between the ages of 6 and 20. In 1948–49 the public schools enrolled 657,359, of whom 436,618 were in elementary grades and 220,741 in junior and senior high schools; 18,315 were enrolled in private and parochial schools. In 1948–49 there were 29,290 teachers in public elementary and secondary schools, of whom 20,064 were white and 9,226 Negro.

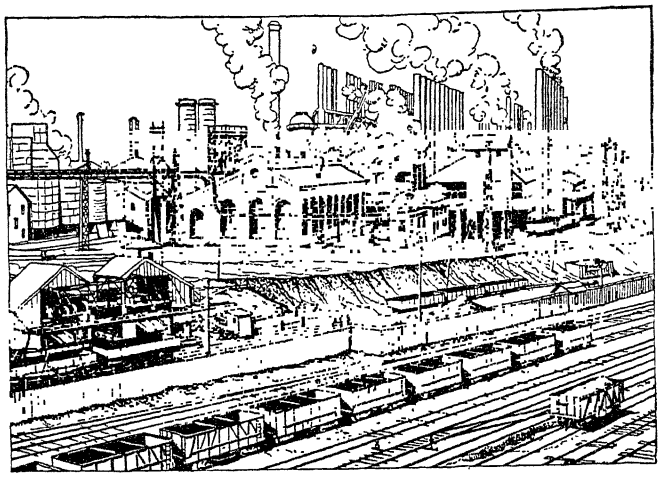
At mid-20th century the chief institutions of higher learning were: the University of Alabama, at Tuscaloosa; Alabama Polytechnic institute, at Auburn; Alabama college, at Montevallo; the state teachers' colleges at Florence, Jacksonville, Livingston and Troy; Athens college (Methodist, for women), at Athens; Birmingham-Southern college (Methodist), at Birmingham;

Howard college (Baptist), at Birmingham; Judson college (Baptist, for women), at Marion; Spring Hill college (Roman Catholic, for men), at Mobile; Huntingdon college (Methodist), at Montgomery; Talladega college (Congregationalist, for Negroes), at Talladega; Tuskegee institute (for Negroes), at Tuskegee; the Agricultural and Mechanical institute (for Negroes), at Normal; the State Teachers' college (for Negroes), at Montgomery; and Stillman college (for Negroes), at Tuscaloosa. Of junior college grade were St. Bernard college, Marion institute, and Snead junior college.

**Charities and Correction.**—Alabama's various philanthropic and penal institutions at mid-20th century included an institution for white deaf and blind and a school for Negro deaf and blind at Talladega; a hospital for insane whites and Negroes at Tuscaloosa and one for Negroes at Mount Vernon; a penitentiary; a state industrial school for white boys and a state training school for white girls, both near Birmingham; a reform school for juvenile Negroes at Mt. Meigs; and a school for mental defectives at Tuscaloosa, all these institutions being under the management of trustees appointed by the governor. The convict-lease system was abolished by the state legislature in 1927, after which convicts were largely employed by the state in highway construction and maintenance and in prison industries at Montgomery, Wetumpka, Speigner and Atmore. In 1901, a system of peonage that had grown up in the state attracted wide attention, and a federal grand jury at a single term of court indicted a number of men for holding persons as peons. Many similar cases were found later in other southern states, but those in Alabama, being the first discovered, attracted the most attention. The federal authorities took active measures to stamp out peonage and were supported by the press and by leading citizens of the state.

**Agriculture.**—Alabama is generally regarded as an agricultural state, but the rural farm population in 1940 was only 47.5% of the population. The number of farms in the state decreased from 262,901 in 1910 to 237,631 in 1925. After rising to 273,455 in 1935, the number declined again to 223,369 in 1945. The value of all crops, which was $56,872,944 in 1879, amounted to $304,348,638 in 1919, after which date it fell off steadily and stood at only $106,100,000 in 1935; it had risen again in 1945 to $298,295,633. In 1945 approximately 45% of the farms were managed by their owners, 6% by part owners, 17% by cash tenants and the remaining 32% by other tenants. Cotton has regularly been the chief agricultural product, though in some years the value of the corn (maize) crop has exceeded it. During the period 1911–15 the average annual cotton yield was 1,463,000 bales. From 1915–25 it was far below the 1,000,000 level, but it jumped for the period 1926–30 to 1,319,000. In 1935 the crop was 1,059,000 bales, but it had fallen in 1940 to 790,000 bales. The next time it exceeded 1,000,000 was in 1948, with 1,167,187 bales. In 1945 the corn harvest totalled 41,875,549 bu. with an approximate value of $65,000,000. The 1945 peanut crop of 328,470,099 lb. was valued at $24,627,328; the sweet potato crop, 5,900,148 bu. at $11,471,988; the hay crop, 486,981 tons at $9,414,368; the white potato crop, 2,896,264 bu. at $3,939,063.

**Minerals.**—An important feature of the industrial life of Alabama since 1880 has been the exploitation of its iron and coal resources. Bituminous coal, first mined near Tuscaloosa about 1827, was produced intensively after 1881; the output grew from 946 tons in 1840 and 13,200 tons in 1870 to 420,000 tons in 1881 and 1,568,000 tons in 1883. In 1923 the output reached 20,457,649 tons, with a value of $51,624,000 and then declined steadily until 1932, when the tonnage was 7,856,939 and the value $12,138,000. The output then rose to 18,800,954 tons, worth $116,626,000, in 1948. Most of this came from Jefferson and Walker counties, although coal underlies about 40% of the northern half of the state. It has been estimated that the total available coal resources of Alabama amount to almost 67,000,000,000 tons or enough for 7,500 years. The iron ore, primarily red hematite, is found chiefly in the region of which Birmingham is the centre. In 1905 Alabama produced 3,782,831 tons of iron ore; in 1923 there were shipped from the mines 6,922,663 tons valued at $15,540,198. Only 1,375,000 tons were mined in 1932, but by 1935 production had risen to 3,240,000 tons, and Alabama stood third among the ore-producing states of the union. Production in 1948 was 11,919,057 tons. Gold, silver, lead, copper, tin, graphite, and bauxite have also been produced. In 1948 Alabama produced minerals to the value of $182,987,000, ranking 16th among the states and producing 1.65% of the product of the whole union, coal, iron ore, cement and clay products being the chief mineral products of the state.



STEEL MILLS IN OPERATION AT BIRMINGHAM, ALABAMA

The coal formation, which underlies about 20% of the area of the State, is responsible for the development of the steel and iron mills that make Birmingham the chief industrial centre of the South

**Manufactures.**—The growth of manufactures in Alabama has been as remarkable as the revelation and exploitation of the state's mineral wealth. In 1880 the capital invested in manufactures was $9,668,008, little more than that of 1860; by 1890 it had increased to $46,122,571; in 1900 it amounted to $70,370,081, in 1919 to $455,592,733. On account of the proximity of coal, iron and limestone to each other, the manufacture of iron and steel, prior to the depression of the 1930s, was the most extensive in the state. The first blast furnace in Alabama was set up in 1818; from then until the Civil War numerous Catalan forges were in operation. In 1876 the first pig iron with coke for fuel was produced. In 1895 it was demonstrated that Alabama pig iron could be sent to Liverpool and sold more cheaply than the English product, and Birmingham (Alabama) came consequently to rank among the world centres of the pig iron trade. The pig iron produced in the state in 1860 was valued at $64,590, in 1900 at $13,487,769, in 1923 at $63,561,614, in 1933 at $10,047,165 and in 1948 at $145,358,582. Manufacture of steel and steel products began in 1888 but was not successful until the Duplex process was used. On account of the irregular quantities of iron and phosphorus present in Alabama ores, this special process, representing a combination of the Bessemer and open-hearth processes, is necessary. In 1923 Alabama ranked seventh among the states in steel production, with an output worth $75,042,823; however, the census of manufactures in 1933 failed to list it among the chief steel-producing states. In 1948 Alabama produced 4.9% of the steel made in the nation, having an annual capacity of 3,548,000 tons. To meet the demand from the iron and steel industries coke production rose to a value of $44,577,384 in 1923 and was $7,091,000 in 1933; in 1948 6,015,460 tons worth $57,611,881 were produced. In 1950 Alabama was the leading state in the production of cast-iron pipe.

A remarkable development of the cement industry occurred after 1910, made possible by the presence of almost inexhaustible deposits of limestone in the heart of rich coal fields, side by side with extensive areas of shale and clay in a territory served by adequate hydroelectric power. In 1924 the output was about 2,000,000 bbl., with a value of $2,645,000; in 1947 the product was 9,510,000 bbl., valued at $16,664,000.

The quantity of lumber and naval stores produced has been

notable. In 1923 the output of sawn lumber was valued at $52,792,121, of which yellow pine represented $46,289,706, oak $1,474,347, and poplar $1,307,823. The total value of lumber cut in 1933 was $14,222,244; in 1948 it was $303,900,000. In 1923, 131 turpentine and rosin factories turned out products valued at $2,809,815; in 1933 the product of 76 active factories was worth $1,661,682.

The manufacture of cotton goods, after a long period of early beginnings, developed rapidly from 1890, in which year there were only 13 cotton mills in the state, one more than in 1850; in 1900 there were 31, with an annual product valued at $8,153,136, representing an increase of 272% over the product ($2,190,771) of 1890; by 1923 there were 61 establishments, employing 20,785 people, with products valued at $86,384,724, and in 1933 there were 75 establishments with 28,762 workers and products worth $66,939,045. The product of all textile industries in the state in 1948 was valued at $485,500,000. During the 1940s the factories of the state consumed more raw cotton than the state produced.

In the 30 years from 1899 to 1929 the annual value added by manufacturing in Alabama increased from $34,112,000 to $258,125,000, but this had declined by 1933 to $113,470,000. In 1947 there were, on the average, 206,136 industrial employees in the state, who received $444,647,000 in salaries, the value added by manufacturing being $876,933,000.

Between 1910 and 1940 the manufacture of hydroelectric power became one of the state's most important industries. By 1950 three great dams had been built across the Coosa river, three across the Tallapoosa, and three across the Tennessee. In 1947 United States government plants and private plants at these dams had a capacity of 959,563 kw., at which time total electric-generating capacity in the state from all sources was 1,348,333 kw.

**Transportation.**—Alabama rivers are navigable for a total distance of some 2,000 mi., but obstructions sometimes prevent the use of a continuous route. The United States government spent millions of dollars on the elimination of these impediments and on the improvement of Mobile harbour. National, state and city funds were used to improve the facilities of the port of Mobile. During the closing months of 1920 the first vessel of a fleet of government-owned-and-operated self-propelled barges made its way down the Mississippi river to New Orleans and through the Mississippi sound to Mobile and then up the rivers to Birmingport and Cordova, in the heart of the Warrior coal fields, a system of locks and dams having canalized the Tombigbee and Warrior rivers, making the latter navigable deep into the mineral region of the Cumberland plateau. An amendment to the state constitution having authorized the use of the credit of the state for the purpose of constructing a great system of docks at Mobile, an act of the legislature at the session of 1923–24 provided for an issue of $10,000,000 of bonds for that purpose, and a special commission was put in charge of the work. The commission acquired for the state approximately 400 ac. of land with a water-frontage of two miles, on the northern outskirts of the city.

The port in 1951 had excellent docking facilities.

Railroads are the main carriers of the products of the mineral region. Here all the large systems of the southern states find an entrance: the Gulf, Mobile and Ohio, the Southern, the Louisville and Nashville, the St. Louis-San Francisco, the Illinois Central, the Seaboard Air Line, the Atlantic Coast Line, and the Central of Georgia forming connections with northern and Atlantic states. The total main-line mileage of railways in the state on Dec. 31, 1948, was 4,742 or 2.11% of the national total.

In 1950 there were 7,634 mi. of state highways, of which 7,119 mi. were paved; there were 52,579 mi. of county roads, of which 2,910 mi. were paved. In 1930 there were 277,146 motor vehicles registered; in 1949 the number was 540,265.

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**"ALABAMA" ARBITRATION.** The facts of this case are as follows: In 1861 the southern states of North America seceded and set up a separate government. Hostilities began with the capture of Fort Sumter by the Confederates on April 13, 1861. On the 19th President Lincoln declared a blockade of the southern ports. On May 14 the British government issued a proclamation of neutrality, by which the Confederates were recognized as belligerents. This example was followed shortly afterwards by France and other states. In June 1862 the vessel, the "Alabama," originally known as "No. 290," was being built by Messrs. Laird at Birkenhead. She was then nearly completed and was obviously intended for a man-of-war. On June 23 Mr. C. F. Adams forwarded to Earl Russell a letter from the United States consul at Liverpool giving certain particulars as to her character. This letter was laid before the law officers, who advised that, if these particulars were correct, the vessel ought to be detained. On July 21 sworn evidence, which was supplemented on July 23, was obtained and laid before the commissioners of customs (who were the proper authorities to enforce the provisions of the Foreign Enlistment Act of 1819), but they declined to move. On July 23, the same evidence was laid before the law officers, who advised that there was sufficient ground for detention. By some accident, the papers were not returned till July 29. Instructions were then issued to seize the vessel, but she had already sailed on the evening of the 28th. Although she remained for two days off the coast of Anglesey, there was no serious attempt at pursuit. She afterwards made her way to the Azores, where she received her armament, which was brought from Liverpool in two British ships. Captain Semmes there took command of her under a commission from the Confederate government.

After a most destructive career she was sunk off Cherbourg by the "Kearsarge" on June 19, 1864.

On these facts the United States government alleged against Great Britain two grievances: first the recognition of the southern states as belligerents and a general manifestation of unfriendliness in other ways; second, the breach of neutrality in allowing the "Alabama," the "Florida," the "Shenandoah" and other Confederate vessels to be built and equipped on British territory.

Correspondence followed extending over several years and in 1871 a commission was appointed to determine the mode in which the questions at issue might be settled. The British commissioners suggested that the "Alabama" should be submitted to arbitration. The American commissioners refused "unless the principles which should govern the arbitrators in the considera-

tion of the facts could be first agreed." Eventually it was agreed that the three following rules should apply: A neutral government is bound—(1) to use due diligence to prevent the fitting out, arming or equipping within its jurisdiction of any vessel, which it has reasonable ground to believe is intended to cruise or to carry on war against a power with which it is at peace, and also to use like diligence to prevent the departure from its jurisdiction of any vessel intended to cruise or carry on war as above, such vessel having been specially adapted, in whole or in part, within such jurisdiction, to warlike use; (2) not to permit or suffer either belligerent to make use of its ports or waters as the base of naval operations against the other, or for the purpose of the renewal, or augmentation of military supplies or arms or the recruitment of men; (3) to exercise due diligence in its own ports and waters and as to all persons within its jurisdiction to prevent any violation of the foregoing obligation and duties. These rules were embodied in the treaty of Washington (1871), which provided that the "Alabama" claims should be referred to a tribunal composed of five arbitrators, one to be named by each of the contracting parties and the remainder by three neutral powers. Art. 6 provided that the arbitrators should be governed by the three rules quoted above, and by such principles of international law not inconsistent therewith as the arbitrators should determine to be applicable to the case. By the same article the parties agreed to observe these rules as between themselves in future, and to bring them to the knowledge of other maritime powers. Art. 7 gave power to the arbitrators to award a sum in gross if Great Britain were adjudged in the wrong.

The treaty was, on the whole, welcomed in England. The United States appointed Mr. C. F. Adams as arbitrator and Mr. J. C. Bancroft Davis as agent. The British government appointed Sir Alexander Cockburn as arbitrator and Lord Tenterden as agent. The arbitrators appointed by the three neutral powers were Count Sclopis (Italy), M. Staempfli (Switzerland), Baron d'Itajuba (Brazil). The first meeting of the tribunal took place on Dec. 15, 1871, in Geneva. As soon as the cases had been formally presented, the tribunal adjourned till the following June. There followed immediately a controversy which threatened the collapse of the arbitration. The United States claimed damages not only for the property destroyed by the Confederate cruisers, but for such "indirect losses" as the transference of the American marine to the British flag, the enhanced payments of insurance, the expenses of pursuit and the prolongation of the war. They also revived the charges of "insincere neutrality" and "veiled hostility" which had figured in the diplomatic correspondence, and had been repudiated by Great Britain, and dwelt at length upon the premature recognition of belligerency, the unfriendly utterances of British politicians and the material assistance afforded to the Confederates by British traders. These claims for indirect losses, etc., caused great excitement in England. That they were within the treaty was disputed, and it was argued that, if they were, the treaty should be amended or denounced. In Oct. 1872 Lord Granville notified to General Schenck, the United States minister, that the British government did not consider that the indirect losses were within the submission, and in April the British counter-case was filed without prejudice to this contention. On June 15 the tribunal reassembled and the American argument was filed. To save the situation Mr. Adams persuaded his colleagues to make a spontaneous declaration that by the principles of international law the indirect claims ought to be excluded from their consideration. The discussion then turned mainly on the question of the measure of "due diligence." The United States contended that it must be a diligence commensurate with the emergency or with the magnitude of the results of negligence. The British government maintained that while the measure of care which a government is bound to use in such cases must be dependent more or less upon circumstances, it would be unreasonable to require that it should exceed that which the governments of civilized States were accustomed to employ in matters concerning their own security or that of their citizens.

The tribunal adopted the view suggested by the United States. It found that Great Britain was legally responsible for all the depredations of the "Alabama" and "Florida" and for those committed by the "Shenandoah" after she left Melbourne.

In the case of the "Alabama" the court was unanimous; in the case of the "Florida" Sir A. Cockburn alone, in that of the "Shenandoah" he and Baron d'Itajuba, dissented from the majority.

In the cases of the other vessels the judgment was in favour of Great Britain.

The tribunal decided to award a sum in gross, and (Sir A. Cockburn again dissenting) fixed the damages at $15,500,000 in gold.

On Sept. 14 the award was formally published, and signed by all the arbitrators except Sir A. Cockburn, who filed a lengthy statement of his reasons.

The first of the Washington Rules, with the substitution of the words "the means at its disposal" for the words "due diligence," was adopted by Art. 8 of the Hague Convention XIII., 1907.

*See* L. A. Atherley-Jones and H. H. L. Bellot, *Commerce in War* (1907). (H. H. L. B.)

**ALABAMA CITY,** formerly a city of Etowah county, Alabama, U.S.A., 60 mi. N.E. of Birmingham; it was annexed to Gadsden (*q.v.*) in 1932.

**ALABAMA RIVER,** a river of Alabama, U.S.A., formed by the Tallapoosa and Coosa rivers, which unite about 6 mi. above Montgomery.

It flows west as far as Selma, then south-west until, about 45 mi. from Mobile, it unites with the Tombigbee to form the Mobile and Tensas rivers, which discharge into Mobile bay.

The course of the Alabama is tortuous; its width varies from 600 to 900ft., depth from 3 to 7ft.; its length by the United States Survey is 312m.; by steamboat measurement, 420m. The river crosses the richest agricultural and timber districts of the State, and railways connect it with the mineral regions of north central Alabama. The principal tributary of the Alabama is the Cahaba (about 200m. long), which enters it about 10m. below Selma. Of the rivers which form the Alabama, the Coosa crosses the mineral region of Alabama, and is navigable for light-draft boats from Rome, Georgia (where it is formed by the junction of the Oostenaula and Etowah rivers), to about 117m. above Wetumpka (about 192m. below Rome and 26m. below Greensport), and from Wetumpka to its junction with the Tallapoosa; the channel of the river has been considerably improved by the Federal government. The navigation of the Tallapoosa river (which has its source in Paulding county, Ga., and is 250m. long) is prevented by shoals and a 60ft. fall at Tallassee, a few miles north of its junction with the Coosa. The Alabama, which is navigable throughout the year, is an important carrier of cotton, cotton seed, fertilizer, cereals, lumber and naval stores.

**ALABASTER** or **ARBLASTIER, WILLIAM** (1567–1640), English Latin poet and scholar, was born at Hadleigh, Suffolk, and was educated at Westminster school and Trinity college, Cambridge. Alabaster served with the expedition of Robert Devereux, earl of Essex, to Cadiz in 1596, and embraced the Roman Catholic faith while he was in Spain. He was imprisoned in the Tower for his religious opinions in 1598 and 1599. His mystical writings brought him into conflict with the Inquisition, and he was imprisoned in Rome for a short time. He escaped, returned to England, abjured Catholicism and received a prebend in St. Paul's Cathedral, which he held until his death in April 1640.

Alabaster's Latin tragedy, *Roxana,* written while he was at Cambridge, is modelled on *La Dalida* of Luigi Groto, and was first published in 1632. Samuel Johnson praised it as the only Latin verse worthy of note written in England before Milton's *Elegies.* One book of an epic poem in praise of Elizabeth, entitled *Elisaeis, apotheosis poetica,* is preserved at Emmanuel college, Cambridge. It was admired by Edmund Spenser. "Who lives that can match that heroic song?" he says in "*Colin Clout's come home againe.*" Other works by Alabaster are mystical in character and owe much to his study of the Kabbala. They include *Apparatus in revelationem Jesu Christi* (Antwerp, 1607), *Ecce*

*Sponsus venit* (1633), *Lexicon Pentaglotton* (1637) and mystical commentaries on Revelations and the Pentateuch.

*See* T. Fuller, *Worthies of England* (ii. 343); Pierre Bayle, *Dictionary, Historical and Critical* (1734); J. P. Collier, *Bibl. and Crit. Account of the Rarest Books in the English Language* (vol. i. 1865); also the *Athenaeum* (Dec. 26, 1903), where Mr. Bertram Dobell describes a ms. in his possession containing 43 sonnets by Alabaster.

**ALABASTER,** a name applied to two different mineral substances. The alabaster of the ancients is mostly a granular aggregate of crystals of calcium carbonate—*i.e.*, it is really a marble (*q.v.*). The alabaster of modern times is a granular form of the mineral gypsum (*q.v.*). It is usually white, pink or yellowish in colour, often with darker streaks and patches, and is very soft (hardness 1·5 to 2) so that it can be scratched by the finger nail. It can be readily distinguished from marble by the fact that it does not effervesce with acid. Alabaster is found in beds interstratified with red sandstones and marls deposited in the beds of salt lakes during an arid period: in England, chiefly in the Keuper marls of the midlands, especially at Chellaston in Derbyshire, Fauld in Staffordshire, and near Newark, Nottinghamshire, also in the neighbourhood of Carlisle, near Watchet in Somerset and Penarth in Glamorgan, all in the Trias.

On the Continent the centre of the alabaster trade is Florence, where it is found in Miocene and Pliocene strata, and is extensively used for statuary work and carving of ornamental objects. The best kind is pure white and translucent, but by careful heating in nearly boiling water it can be made nearly opaque, resembling marble. This appears to be due to partial dehydration.

(R. H. Ra.)

**ALABASTROS** or **ALABASTOS,** a Greek vase, shaped like an urn. The most common type of the alabastros stands on a base that balances, in appearance, its rather wide mouth. (*See* Pottery and Porcelain: *Greek Pottery.*)

**ALACALUF,** an Indian tribe, almost extinct, living in the west Patagonian channels, chiefly in the vicinity of Ración sound. Formerly they were much more numerous, and their canoes might be seen southward from the Gulf of Peñas to Brecknock peninsula in Tierra del Fuego, including the Straits of Magellan. Their culture in general closely resembles that of the other canoe-using tribe of Tierra del Fuego, the Yahgan (*q.v.*). The use of planked canoes by the Alacaluf has suggested the possibility of culture transference from Polynesia, but the Alacaluf planked canoe is demonstrably a local development.

*See* J. M. Cooper, "Analytical and Critical Bibliography . . . of Tierra del Fuego," in *Bureau of American Ethnology Bulletin 63* (1917). (S. K. L.)

**ALACOQUE** or **AL COQ, MARGUERITE MARIE** (1647–1690), French nun and founder of the devotion to the Sacred Heart of Jesus, was born at Lauthecourt on July 22, 1647, and died on Oct. 17, 1690. Having been cured of paralysis, as she believed by the intercession of the Blessed Virgin, in 1671 she entered the Visitation convent at Paray-le-Monial and in the following year made her final vows. After a long period of severe austerities she testified that Christ had revealed to her His heart burning with love for man, and bade her establish the Holy Hour, communion on the first Friday of the month and the feast of the Sacred Heart to be observed on the Friday after the octave of Corpus Christi. The devotion to the Sacred Heart spread rapidly throughout Christendom, and Marguerite Marie was pronounced venerable in 1824, blessed in 1864, and finally on May 13, 1920, was canonized.

Her writings and autobiography are contained in *Vie et Oeuvres par les Contemporaines,* 2 vols. (Paris, 1901), her autobiography being published again at Paray-le-Monial in 1918. *See* also E. Bougaud, *Life of St. Margaret Mary Alacoque* (New York, 1920).

**ALAGOAS,** a maritime state of Brazil, bounded north and west by the State of Pernambuco, south and west by the State of Sergipe, and east by the Atlantic. It has an area of 11,031 square miles. A dry, semi-barren plateau, fit for grazing only, extends across the western part of the State, breaking down into long fertile valleys and wooded ridges towards the coast, giving the country a mountainous character. The coastal plain is filled with lakes (*lagoas*), in some cases formed by the blocking up of river outlets by beach sands. The valleys and slopes are highly fertile and produce sugar, cotton, tobacco, Indian corn, rice, mandioca and fruits. Hides and skins, mangabeira rubber, cabinet woods, castor beans and rum are also exported. Cattle-raising was formerly a prominent industry, but it has greatly declined. Manufactures were developed to a limited extent only, though protective tariff laws were adopted for their encouragement. The climate is hot and humid, and fevers are prevalent in the hot season. The capital, Maceió (pop. 124,544), is the chief commercial city of the state, and its port (Jaraguá) has a large foreign and coastwide trade. The principal towns are Alagoas, formerly the capital, picturesquely situated on Lake Manguaba, 15 mi. southwest of Maceió, Palmeira dos Indios (pop. 67,202) and Santana do Ipanema (pop. 61,456). Before 1817 Alagoas formed part of the *capitania* of Pernambuco, but in that year the district was rewarded with a separate government and in 1823 became a province of the empire. The advent of the republic in 1889 changed the province into a state. Pop. (1950) 1,106,454.

**ALAIN DE LILLE** (Alanus de Insulis) (*c.* 1128–1202), French theologian and Latinist, lived at Montpellier, and finally retired to the Abbey of Citeaux, where he remained until his death. His varied learning won for him the title of *Doctor universalis.* He was famed in his day for two of his Latin poems, *De planctu naturae,* a satire on human vices, and *Anticlaudianus,* a long verse treatise on the arts and on morals. Alain shared in the reaction against scholasticism, and laid stress on the share of faith in the apprehension of religious truth. He must be classed with the so-called Summists. But his *De arte seu de articulis catholicae fidei,* which was a "summa" of Christian theology, brings the principles of mathematical science to bear on Christian dogma. He also wrote a treatise *contra haereticos.*

The works of Alain de Lille have been published by Migne, *Patrologia latina,* vol. ccx. A critical edition of the *Anticlaudianus* and of the *De planctu naturae* is given by Th. Wright in vol. ii. of the *Anglo-Latin Satirical Poets and Epigrammatists of the Twelfth Century* (London, 1872). *See* Hauréau, *Mémoire sur la vie et quelques oeuvres d'Alain de Lille* (Paris, 1885); M. Baumgartner, *Die Philosophie des Alanus de Insulis* (Münster, 1896).

**ALAIS:** *see* Alès.

**ALAJUELA,** a province of Costa Rica, Central America, extending southward from the border of Nicaragua to the Meseta Central: area, 3,653 sq.mi.; pop. (1940), 137,943. The capital of the province (Alajuela), served by the Pan American highway and a branch line of the coast-to-coast railway, is in the highly productive and populous central valley: elev., 3,185 ft.; mean annual temp., 68° F.; pop. (1940), 9,232.

The province is predominantly agricultural in its economy, producing large quantities of sugar cane, coffee, cereals, fruits, subsistence crops and cattle.

**ALAMANNI** or **ALLEMANNI,** a German people first mentioned by Dio Cassius. They dwelt in the basin of the Maine, to the south of the Chatti (*q.v.*). They were a conglomeration of various tribes. The Hermunduri formed the preponderating element, and there were among the others the Iuthungi, Bucinobantes and Lentienses. From the 4th century A.D. onwards we hear also of the Suebi (*q.v.*) or Suabi. The Hermunduri belonged to the Suebi, but reinforcements from new Suebic tribes now moved westward. In later times the names Alamanni and Suebi seem to be synonymous. They were continually engaged in conflicts with the Romans, the most famous encounter being that at Strassburg, in which they were defeated by Julian (A.D. 357). Early in the 5th century the Alamanni crossed the Rhine and conquered and settled Alsace and a large part of Switzerland. In A.D. 495 they were conquered by Clovis, from which time they formed part of the Frankish dominions. The Alamannic and Swabian dialects survive in Swiss dialects, and in parts of South Germany, particularly Baden and Württemburg and also parts of Alsace.

*See* Dio Cassius lxvii. et seq.; Ammianus Marcellinus, *passim;* Gregory of Tours, *Historia Francorum,* book ii.; O. Bremer in H. Paul, *Grundriss der germanischen Philologie* (2nd ed., Strasbourg, 1900), vol. iii. pp. 930 *et seq.*

**ALAMANNI** or **ALEMANNI, LUIGI** (1495–1556), Italian statesman and poet, was born at Florence. Luigi joined with others in an unsuccessful conspiracy against Giulio de' Medici, afterwards Pope Clement VII. He was obliged to take refuge in Venice, and, on the accession of Clement, to flee to France. When Florence shook off the papal yoke in 1527, Alamanni returned, and took a prominent part in the management of the affairs of the republic. On the restoration of the Medici in 1530 he had again to take refuge in France, where he enjoyed the favour both of Francis I and Henry II. He died at Amboise on April 18, 1556. His best work, *La Coltivazione* (Paris, 1546), is a didactic poem, written in imitation of Virgil's *Georgics*. His *Opere Toscane* (Lyons, 1532) consists of satirical pieces written in blank verse. An unfinished poem, *Avarchide*, in imitation of the *Iliad*, was the work of his old age and has little merit. It has been said by some that Alamanni was the first to use blank verse in Italian poetry, but the distinction belongs rather to his contemporary Giangiorgio Trissino. He also wrote a poetical romance, *Girone il Cortese* (Paris, 1548); a tragedy, *Antigone;* a comedy, *Flora,* and other poems. His works were published, with a biography, by P. Raffaelli, as *Versi e prose di Luigi Alamanni* (Florence, 1859).

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**ALAMBAGH,** the name of a large park or walled enclosure, containing the ruins of a country house of the old Oudh court, as well as a beautiful garden, situated about 4m. from Lucknow, near the Cawnpore road, in the United Provinces of India. It was converted into a fort by the mutineers in 1857, and after its capture by the British was of importance in connection with the military operations around Lucknow. Sir Henry Havelock was buried in the garden.

**ALAMEDA,** a city of Alameda county, California, U.S.A., an island approximately 1 mi. wide and 5½ mi. long, at the eastern or mainland side of San Francisco bay, 12 mi. E. of the city of San Francisco. One entire side, 5½ mi. in length, faces on a deepwater channel and is used largely as a commercial waterfront. The city of Alameda is connected by the Posey tube and four bridges with its neighbouring cities, including the city of Oakland, and thence with the San Francisco Bay bridge. Pop. (1950) 63,425; (1940) 36,256.

Although largely residential, Alameda is important for its shipbuilding yards and ship-repair and dry-dock facilities. The city has both heavy and light industrial plants, including food and candy factories. Shipping terminals and warehouses have direct access to water and rail facilities and barge and trucking services. There are large plants for oil storage and distribution.

Alameda is the site of a U.S. naval air station, a maritime commission training school, a coast guard base and an army depot. The city was incorporated in 1854 and in 1917 adopted a city-manager form of government with five councilmen elected by the people. It owns and operates its own electric distributing plant and a golf course. There are swimming and fishing facilities and a yacht harbour and boat clubs facing out on the surrounding waters. Gross assessed valuation in 1950 was $43,458,610.

**ALAMO, THE,** historic building in San Antonio, Tex., noted as the scene of a heroic defense in the war between Texas and Mexico. This building is the chapel of the Mission San Antonio de Valero, founded in 1718 by Franciscans, and commonly called the "Alamo mission" from the grove of cottonwood (*alamo*) in which it stood. It originally consisted of the chapel, a convent yard about 100 ft. square, a convent and hospital building and a plaza about 2½ ac. in extent, the whole being surrounded by a strong wall. Upon the disappearance of the Indians from the vicinity the mission was abandoned, and after 1793 it was sometimes used as a fort. In the war for Texan independence Cols. William B. Travis, James Bowie and Davy Crockett, with 180 men, were attacked there by 4,000 Mexicans commanded by Antonio Lopez de Santa Anna. After a siege lasting 13 days, Feb. 23–March 6, 1836, during which about 500 of the attacking force were killed, a breach was made in the walls. In a final assault the Mexicans overpowered and slaughtered the garrison in a hand-to-hand struggle in the chapel, the five survivors being subsequently killed in cold blood by order of Santa Anna. "Remember the Alamo" became the war cry of the Texans who, under Sam Houston, at San Jacinto, on April 21, 1836, defeated and captured Santa Anna. In 1883 the Alamo building was bought by the state and preserved as a public monument, and in 1913 the city of San Antonio began its restoration.

*See* A. M. Williams, *Sam Houston and the War of Independence in Texas* (1893); Zavola, *Story of the Siege and Fall of the Alamo* (1911).

**ALAMOS DE BARRIENTOS, BALTASAR** (1555–1640), Spanish scholar, was born at Medina del Campo in 1555. His friendship with Antonio Pérez (*q.v.*) caused him to be arrested in 1590 and imprisoned for nearly 13 years. His *Tácito español ilustrado con aforismos* (Madrid, 1614) is the only work which bears his name, but he is probably author of the *Discurso del gobierno* ascribed to Pérez. Through the influence of Pedro de Lerma and Gaspar Olivares (*q.v.*) he later attained high position.

**ÅLAND ISLANDS,** an archipelago at the entrance to the Gulf of Bothnia, about 25 mi. from the coast of Sweden, and 15 mi. from that of Finland. Area 572 sq.mi., with a population of 21,196 (1940). The group which forms the Finnish department of Åland (Ahvenanmaa), consists of nearly 300 islands, of which about 80 are inhabited, the remainder being desolate rocks. These islands form a continuation of a dangerous granite reef extending along the south coast of Finland. They formerly belonged to Sweden, and in the neighbourhood the first victory of the Russian fleet over the Swedes was gained by Peter the Great in 1714. They were ceded to Russia in 1809, and remained Russian until 1917, when Finland was proclaimed an independent and sovereign state. The population centres chiefly in the island of Åland, upon which is the small town Mariehamn. The inhabitants, hardy seamen and fishermen, are mostly of Swedish descent and speech. The surface of the islands is generally sandy, the soil thin and the climate keen; yet Scotch fir, spruce and birch are grown; and rye, barley, flax and vegetables are produced. Great numbers of cattle are reared; and cheese, butter and hides, as well as salted meat and fish, are exported. There are several excellent harbours (notably that of Ytternäs), which were of great importance to Russia from the fact that they are frozen up for a much briefer period than those on the coast of Finland.

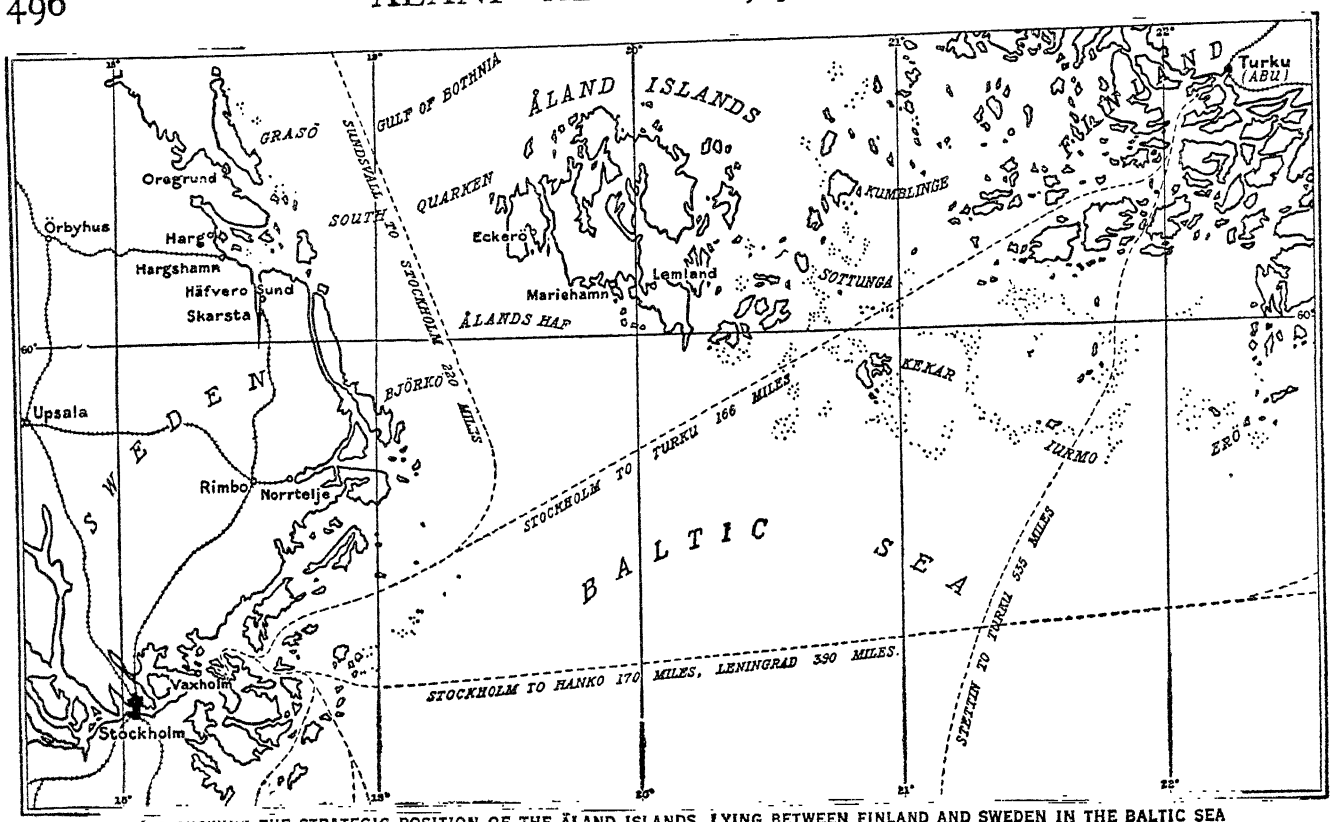
**History.**—When, by an article of the Treaty of Fredrikshavn (Friedrichshamn), Sept. 5–17, 1809, the islands were ceded to Russia, together with the territories forming the grand-duchy of Finland on the mainland, the Swedes were unable to secure a provision that the islands, occupying a position of great strategic importance in relation to the entrance to Stockholm and to the Gulf of Bothnia, should not be fortified. The question was a vital one for Great Britain's trade as well. In 1854, accordingly, during the Crimean War, an Anglo-French force destroyed the fortress of Bomarsund. By the "Åland Convention," between Great Britain, France and Russia on March 30, 1856, it was stipulated that "the Åland islands shall not be fortified, and that no military or naval establishments shall be maintained or created on them."

By the 33rd article of the Treaty of Paris (1856) this convention, annexed to the final act, was given "the same force and validity as if it formed part thereof."

In 1906 it was asserted that Russia, under pretext of stopping the smuggling of arms into Finland, was massing considerable forces at the islands.

The question of the Åland islands created discussion in 1907 and 1908 in connection with the new North sea agreements, but Russia did not raise the issue officially when she saw the aversion of the other powers even to discuss it.

Under the tsardom the islands were united with Finland until the latter country declared her independence in 1917. In Dec. 1917, the Åland islanders claimed the right of self-determination on their own account, and unofficial plebiscites showed a vote in favour of reunion with Sweden. Finland granted the islands autonomy on May 7, 1920, but refused to contemplate their secession. In June the leaders of the secession movement were




**MAP SHOWING THE STRATEGIC POSITION OF THE ÅLAND ISLANDS, LYING BETWEEN FINLAND AND SWEDEN IN THE BALTIC SEA**

The Åland Islands, a self governing group within the Finnish body politic, were guarded by Russia for over a century because of their strategic position in the Baltic sea. They acquired the right of self determination after the World War (1914–18) and were guaranteed neutralization by the Baltic powers. The majority of the inhabitants are Swedish

arrested for high treason, and Finnish troops were sent to the island. As this situation was producing a state of serious tension between Finland and Sweden, Great Britain drew the attention of the Council of the League of Nations to the movement on June 19, 1920.

With the consent of the two interested governments, the Council asked a special commission of jurists whether the question was international or the exclusive concern of Finland. This commission declared the question international, whereupon the Council despatched a special commission of inquiry to the spot. This commission reported against the claim of the islanders to secede from Finland, but declared that the islanders formed a distinct group within the Finnish body politic, and suggested that the maintenance of Finnish sovereignty ought to be made conditional upon the incorporation in the autonomy law of May 7, 1920, of five specific guarantees. The commission also reported in favour of a new convention, to be signed by all the Baltic powers, for the neutralization and demilitarization of the Åland Islands, to replace the international convention of March 30, 1856. This report was accepted by the Council and the two nations. The new neutralization convention came into effect April 6, 1922. After much discussion Finland and Sweden agreed upon strengthening the defenses of the islands (Jan. 1939); the other interested states agreed except for Russia, whose protest postponed action. At the end of the same year Russia invaded Finland. In the peace agreement of March 1940, Russia demanded no concessions in the Åland Islands.

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**ALANI,** eastern division of the Sarmatians, half-caste Scyths, a wandering people resembling Mongols. First met with north of the Caspian, then (*c.* 1st century A.D.) spreading into the steppes of Russia, the Alani made incursions into both the Danubian and the Caucasian provinces of the Roman empire. By the Huns they were cut into two portions, of which the western joined the Germanic nations in their invasion of southern Europe, and, following the fortunes of the Vandals, disappeared in North Africa. Those of the eastern division, though dispersed about the steppes until late mediaeval times, were forced by fresh invading hordes into the Caucasus, where they remain as the Ossetes. (*See* SARMATAE and SCYTHIA.)

**ALANINE,** *α Alanine*, is a constituent, and decomposition product, of many proteins, soluble in water or alcohol, crystallizing in colourless, sharp rhombic prisms, and having marked physiological action.

It has the formula of *α* amino-proprionic acid, $NH_2{\cdot}CHMe{\cdot}CO_2H$, and exists in the *d*-, *l*- and *r*-isomeric forms (*see* ISOMERISM).

**ALAPAEVSK,** a town in Sverdlovsk region of Russian S.F.S.R. Pop. 12,151. Lat. 57° 49′ N. Long., 61° 40′ E. It was known for its copper as long ago as 1704, and is in the copper and iron mining area. Since it was linked by rail with Sverdlovsk and Nizhni-Tagil, its importance has greatly increased.

**ALARCON, HERNANDO DE,** Spanish navigator of the 16th century, was sent by the viceroy of New Spain in 1540 to give naval support to the expedition of Francisco Vasquez de Coronado in his search for the mythical seven cities of Mexico. The junction was never effected. Alarcon sailed up the Gulf of California, and determined with certainty that California was a peninsula, not an island.

He surveyed the coast, ascended the Rio del Tizon or Rio de Buena Guia (Colorado) for 85 Spanish miles and planted a cross at the highest point he reached.

Under the cross he buried a note afterwards found by Melchior Diaz.

*See* Herrera, Decade VI. book ix. ch. 15; vol. vi. fol. 212 of Madrid edition of 1730, and the report printed in Hakluyt's voyages.

**ALARCON, JUAN RUIZ DE** (*c.* 1581–1639), Spanish dramatist, was born about 1581 at Tlacho (Mexico), where his father was superintendent of mines, and died at Cordova on Aug. 4, 1639. Alarcon was educated in Spain, then, after a brief stay in

Mexico, returned to Spain and occupied a small post under the Council of the Indies. His plays were published in 1628 and 1634; the most famous of these is *La Verdad sospechosa,* which was adapted by Corneille as the *Menteur.* Alarcon was preoccupied with ethical aims, and his gift of dramatic presentation was as brilliant as his dialogue was natural and vivacious. It has been alleged that his foreign origin is noticeable in his plays, but in *El Tejedor de Segovia* he had produced a masterpiece of national art, national sentiment and national expression.

**ALARCON, PEDRO ANTONIO** (1833–1891), Spanish writer, was born at Guadix March 10 1833. He had a considerable reputation as a journalist and poet when his play, *El Hijo pródigo,* was hissed off the stage in 1857. The failure exasperated Alarcon so much that he enlisted under O'Donnell as a volunteer in the Moroccan campaign. The expedition provided the material for the brilliant *Diario de un testigo de la guerra de Africa* (1859), a masterpiece in its way as a description of campaigning life. On his return from Morocco, Alarcon did great service to the liberal cause as editor of *La Politica.* But in the years 1868–74 he ruined his political reputation by a series of rapid changes of front. His literary reputation steadily increased, however. *El sombrero de tres picos* (1874), a clever resetting of an old Spanish tale, lives for its malicious wit and minute observation. His other works include *Cuentos amatorios* (1881); *Historietas nacionales* (1881); *El Escandalo* (1875); *El Capitan Veneno* (1881). Alarcon died July 20, 1891.

**ALARD, JEAN DELPHIN** (1815–1888), famous French violinist and teacher, was professor at the Paris Conservatoire from 1843 to 1875. Sarasate was one of his pupils.

**ALARIC** (*c.* 370–410), Gothic conqueror, the first Teutonic leader who stood as a conqueror in the city of Rome, was probably born about 370 on an island named Peucè (the fir) at the mouth of the Danube. He was of noble descent, his father being a scion of the family of the Balthi or Bold-men, next in dignity among Gothic warriors to the Amals. He was a Goth and belonged to the western branch of that nation (sometimes called the Visigoths) who at the time of his birth were quartered in the region now known as Bulgaria, having taken refuge on the southern shore of the Danube from the pursuit of their enemies the Huns.

In the year 394 he served as a general of *foederati* (Gothic irregulars) under the Emperor Theodosius in the campaign in which he crushed the usurper Eugenius. As the battle which terminated this campaign, the battle of the Frigidus, was fought near the passes of the Julian Alps, Alaric probably learnt at this time the weakness of the natural defences of Italy on her north-eastern frontier.

In the shifting of offices which took place at the beginning of the reigns of Arcadius and Honorius, the sons of Theodosius, Alaric apparently hoped that he would receive one of the great war ministries of the empire, and thus instead of being a mere commander of irregulars would have under his orders a large part of the imperial legions. This, however, was denied him, and he remained an officer of *foederati.* His disappointed ambition prompted him to take the step for which his countrymen were longing, for they too were grumbling at the withdrawal of the "presents," in other words the veiled ransom-money, which for many years they had been accustomed to receive. They raised him on a shield and acclaimed him as a king; leader and followers both resolved (says Jordanes, the Gothic historian) "rather to seek new kingdoms by their own labour, than to slumber in peaceful subjection to the rule of others."

Alaric struck first at the eastern empire. He marched to the neighbourhood of Constantinople, but finding himself unable to undertake the siege of the city, he retraced his steps westward and marched southward through Thessaly and the unguarded pass of Thermopylae into Greece. Alaric's invasion of Greece lasted two years (395–96); he ravaged Attica but spared Athens, which at once capitulated to the conqueror, and penetrated into Peloponnesus, capturing its most famous cities, Corinth, Argos and Sparta, selling many of their inhabitants into slavery. Here, however, his victorious career ended. Stilicho, who had come a second time to the assistance of Arcadius, succeeded in shutting up the Goths in the mountains of Pholoe on the borders of Elis and Arcadia. Alaric escaped with difficulty, and not without some suspicion of connivance on the part of Stilicho. He crossed the Corinthian gulf and marched with the plunder of Greece northwards to Epirus.

Next came an astounding transformation. For some mysterious reason, probably connected with the increasing estrangement between the two sections of the empire, the ministers of Arcadius conferred upon Alaric the government of part of the important prefecture of Illyricum. Here, ruling the Danubian provinces, he was on the confines of the two empires, and, in the words of the poet Claudian, he "sold his alternate oaths to either throne," and made the imperial arsenals prepare the weapons with which to arm his Gothic followers for the next campaign. It was probably in the year 400 that Alaric made his first invasion of Italy, co-operating with another Gothic chieftain named Radagaisus. After spreading desolation through north Italy, and striking terror into the citizens of Rome, Alaric was met by Stilicho at Pollentia (a Roman municipality in what is now Piedmont). The battle (April 6, 402, Easter day) was a victory, though a costly one, for Rome and effectually barred the further progress of the barbarians. Alaric was an Arian Christian who trusted to the sanctity of Easter for immunity from attack, and the enemies of Stilicho reproached him for having gained his victory by taking an unfair advantage of the great Christian festival. The wife of Alaric is said to have been taken prisoner after this battle; and there is some reason to suppose that he was hampered in his movements by the presence with his forces of large numbers of women and children, having given to his invasion of Italy the character of a national migration. After another defeat before Verona, Alaric quitted Italy, probably in 403.

He had not indeed reached Rome, but his invasion of Italy had produced important results. It had caused the imperial residence to be transferred from Milan to Ravenna, it had necessitated the withdrawal of the 20th legion from Britain, and it had probably facilitated the great invasion of Vandals, Suevi, and Alani into Gaul, by which that province and Spain were lost to the empire. We next hear of Alaric as the friend and ally of his late opponent Stilicho. The estrangement between the eastern and western courts had in 407 become so bitter as to threaten civil war, and Stilicho was actually proposing to use the arms of Alaric in order to enforce the claims of Honorius to the prefecture of Illyricum. The death of Arcadius in May 408 caused milder counsels to prevail in the western cabinet, but Alaric, who had actually entered Epirus, demanded that if he were thus suddenly bidden to desist from war, he should be paid handsomely for what in modern language would be called the expenses of mobilization. The sum which he named was a large one. 4,000 pounds of gold (about £160,000 sterling), but under strong pressure from Stilicho the Roman senate consented to promise its payment.

Three months later Stilicho himself and the chief ministers of his party were treacherously slain in pursuance of an order extracted from the timid and jealous Honorius; and in the disturbances which followed the wives and children of the barbarian *foederati* throughout Italy were slain. The natural consequence was that these men to the number of 30,000 flocked to the camp of Alaric, clamouring to be led against their cowardly enemies. He accordingly crossed the Julian Alps, and in Sept. 408 stood before the walls of Rome (now with no capable general like Stilicho to defend her) and began a strict blockade.

No blood was shed this time; hunger was the weapon on which Alaric relied. When the ambassadors of the senate in treating for peace tried to terrify him with their hints of what the despairing citizens might accomplish, he gave with a laugh his celebrated answer, "The thicker the hay, the easier mowed!" After much bargaining, the famine-stricken citizens agreed to pay a ransom of more than a quarter of a million sterling, besides precious garments of silk and leather and three thousand pounds of pepper. Thus ended Alaric's first siege of Rome. At this time, and indeed throughout his career, the one dominant idea of Alaric was not to pull down the fabric of the empire but to secure for himself, by negotiation with its rulers, a regular and recognized position within its borders. His demands were certainly large—the concession of

a block of territory 200 m. long by 150 wide between the Danube and the Gulf of Venice (to be held probably on some terms of nominal dependence on the empire), and the title of commander-in-chief of the imperial army. As all attempts to conduct a satisfactory negotiation with this emperor failed, Alaric, after instituting a second siege and blockade of Rome in 409, came to terms with the senate, and with their consent set up a rival emperor and invested the prefect of the city, a Greek named Attalus, with the diadem and the purple robe. But Attalus rejected the advice of Alaric and lost in consequence the province of Africa, the granary of Rome, which was defended by the partisans of Honorius. The weapon of famine, formerly in the hand of Alaric, was thus turned against him, and loud in consequence were the murmurs of the Roman populace. Honorius was also greatly strengthened by the arrival of six legions sent from Constantinople to his assistance by his nephew Theodosius II. Alaric therefore cashiered his puppet emperor Attalus after 11 months of ineffectual rule, and once more tried to reopen negotiations with Honorius. These negotiations would probably have succeeded but for the malign influence of another Goth, Sarus, the hereditary enemy of Alaric and his house. When Alaric found himself once more outwitted, he marched southward and began in deadly earnest his third siege of Rome. No defence apparently was possible; there are hints, not well substantiated, of treachery; there is greater probability of surprise. However this may be (for our information at this point of the story is miserably meagre) on Aug. 24, 410, Alaric and his Goths burst in by the Salarian Gate on the north-east of the city. The Goths showed themselves not absolutely ruthless conquerors, and there is no reason to attribute any extensive destruction of the buildings of the city to Alaric and his army. Contemporary ecclesiastics recorded with wonder many instances of their clemency: the Christian churches saved from ravage; protection granted to vast multitudes both of pagans and Christians who took refuge therein; vessels of gold and silver, which were found in a private dwelling, spared because they "belonged to St. Peter"; at least one case in which a beautiful Roman matron appealed, not in vain, to the better feelings of the Gothic soldier who had assailed her.

Alaric then marched southwards into Calabria. He desired to invade Africa, which on account of its corn crops was now the key of the position; but his ships were dashed to pieces by a storm in which many of his soldiers perished. He died soon after, probably of fever, and his body was buried under the river-bed of the Busento, the stream being temporarily turned aside from its course while the grave was dug wherein the Gothic chief and some of his most precious spoils were interred. When the work was finished the river was turned back into its usual channel, and the captives by whose hands the labour had been accomplished were put to death that none might learn their secret. He was succeeded in the command of the Gothic army by his brother-in-law, Ataulphus.

Our chief authorities for the career of Alaric are the historian Orosius and the poet Claudian, both strictly contemporary; Zosimus, a somewhat prejudiced heathen historian, who lived probably about half a century after the death of Alaric; and Jordanes, a Goth who wrote the history of his nation in the year 551, basing his work on the earlier history of Cassiodorus (now lost), which was written *c.* 520.

(T. H.; X.)

**ALARIC II.** (d. 507), eighth king of the Goths in Spain, succeeded his father Euric, or Evaric, on Dec. 28, 484. His dominions not only included the whole of Spain except its north-western corner, but also Aquitaine and the greater part of Provence. In religion Alaric was an Arian, but he greatly mitigated the persecuting policy of his father, Euric, towards the Catholics and authorized them to hold, in 506, the council of Agde. He appointed a commission to prepare an abstract of the Roman laws and imperial decrees, which should form the authoritative code for his Roman subjects. This is generally known as the *Breviarium Alaricianum*, or *Breviary of Alaric* (*q.v.*). Alaric endeavoured strictly to maintain the treaty which his father had concluded with the Franks, but Clovis found a pretext for war in the Arianism of Alaric. The two armies met in 507 at the Campus Vogladensis, near Poitiers, where the Goths were defeated, and their king, who took to flight, was overtaken and slain, it is said, by Clovis himself. This battle ended the rule of the Visigoths in Gaul.

**ALA-SHEHR** (anc. PHILADELPHIA), Aidin vilayet, Turkey. in the Kuzu Chai valley (*Cogamus*), at the foot of the Boz Dagh (Mt. Tmolus) 83 mi. east of Smyrna (105 by railway). Population 32,801. Philadelphia was founded by Attalus II. of Pergamum about 150 B.C., became one of the "Seven Churches" of Asia, and was called "Little Athens" on account of its festivals and temples. It was subject to frequent earthquakes. Philadelphia was an independent neutral city, under the Latin Knights of Rhodes, when taken in 1390 by Sultan Bayezid I. and an auxiliary Christian force under the emperor, Manuel II., after a long resistance, when all other cities of Asia Minor had surrendered. Twelve years later it was captured by Timur, who built a wall with the corpses of his prisoners. A fragment of the ghastly structure is in the library of Lincoln cathedral. The town is connected by railway with Afiun Qarahisar and Smyrna. It is ill-built, but, as it stands above the wide fertile Hermus plain, the distant view is imposing. There are small industries and a fair trade. A mineral spring yields a heavily charged water, "Eau de Vals," in great request in Smyrna.

*See* W. M. Ramsay, *Letters to the Seven Churches* (1904).

**ALAS, LEOPOLDO** (1852–1901), Spanish novelist and critic, was born at Zamora. His reputation rests on his psychological novel, *La Regenta* (1884–85), whose scene is laid in Oviedo. The ruthless analysis of its characters gives it a place among the best novels of the period.

**ALASKA,** once called Russian America, is a territory of the United States of America, occupying the extreme northwestern part of North America and including the adjacent islands. The name "Alaska", an adaptation of the Aleut "A-la-as-ka," means "the great country." The territory of Alaska comprises first, all that part of the continent west of the 141st meridian; secondly, the eastern Diomede Island in Bering strait, and all islands in Bering sea and the Aleutian chain lying east of a line drawn from the Diomedes to pass midway between Copper Island, off Kamchatka, and Attu Island of the Aleutians; thirdly, a narrow strip of coast and adjacent islands north of a line drawn from Cape Muzon, in latitude 54° 40′ N., up Portland canal to its head, and thence, following the summit of the mountains situated parallel to the coast to the 141st meridian, provided that when the line runs more than ten marine leagues from the ocean the limit shall be formed by a line parallel to the windings of the coast and which shall never exceed the distance of ten marine leagues therefrom. Alaska is bounded on the north by the Arctic ocean, on the west by the Arctic ocean, Bering sea and Bering strait, on the south and southwest by the Gulf of Alaska and the Pacific ocean, and on the east by British Columbia and Yukon territory. The total area of Alaska is 586,400 sq.mi., an area equal to nearly one-fifth that of continental United States or more than twice the size of Texas, the largest state of the union.



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

A RAVEN TOTEM POLE

Totem poles are erected by the Alaskan Indians to the animal from which they think their tribe has descended

**Principal Physical Features.**—As indicated by the above boundaries, Alaska is of straggling, irregular shape, extending in longitude from about 130° W. to 193° W. or 167° E., as specified in the articles of cession and through more than 20° of latitude, 51° to 71° 25′ N. The southern limit lies far out in the Pacific as part of the Aleutian island chain, only 2° north of the boundary between the western half of the United States and Canada. Alaska consists of a compact central mass and two straggling appendages running from its southwestern and southeastern corners. These three parts will be referred to hereafter respectively, as continental Alaska, Aleutian Alaska and the "Panhandle."

The general ocean coast line is about 4,750 mi. and including the islands, bays, inlets and rivers to the head of tide water, is about

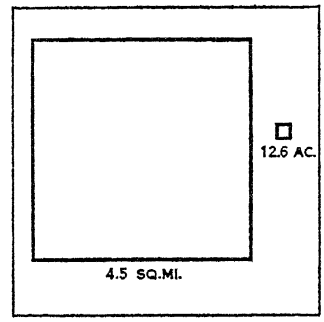
26,000 mi. in length. The entire southern coast is very precipitous, much indented by deep fiords, with only slight stretches of beach or plain. Its elevation gradually decreases as one travels west toward the Aleutians.

A great submarine platform extends throughout a large part of Bering sea. The western and northern coasts are regular in outline, with long straight beaches, and shallows are common in the seas that wash them.

Of the vast number of islands within the boundaries of Alaska and constituting part of its territory, only a few of the more important can be mentioned in an article of this scope. At the southeastern extremity and lying close inland is the Alexander archipelago (*q.v.*) consisting of about 1,100 islands, large and small. Southwest of the Alaska peninsula there are two groups: (1) Kodiak; the largest island, of the same name, is 40 mi. by 100 mi., and may be considered a continuation of the Kenai peninsula. The group's western continuation consists of the Semidi, Shumagin and Sanak clusters; (2) the Aleutian Islands (*q.v.*), sweeping 1,200 mi. or more W.S.W. from the end of Alaska peninsula; west of the mainland in Bering sea, the Pribilof Islands, about 500 mi. S. of Cape Prince of Wales, the small Hall and St. Matthew Islands; to the north, toward Bering strait, the large St. Lawrence Island, with Nunivak near the coast to the southeast. Of the smaller islands within Bering sea, only the Pribilofs (home of the fur seal during breeding season) are of special interest or value.

Alaska has mountains, plateaus and lowlands on a grand scale. "In a broad way, the larger features of topography correspond with those of the western States. There is a Pacific mountain system, a central plateau region, a Rocky mountain system, and a Great plains region. These four divisions are well marked, and show the close geographic relation of this area to the southern part of the continent." But the general features of the Pacific mountain system trend parallel to the coast line of the Gulf of Alaska. The Pacific mountain system includes four ranges. The coast range of the Panhandle attains a width of 100 mi., but has no well-defined crestline. The range is characterized by summit levels between 5,000 and 10,000 ft. Continuing the coast range, with which it is closely associated—the Chilkat river lies between them—is the St. Elias range (a term used to include not only the mountains between Cross sound and Mt. St. Elias but the Chugach, Wrangell and Nutzotin mountains), lying in the southeast of the main peninsula or continental Alaska. Among its principal peaks are: Mt. Sanford, Mt. Fairweather and Mt. Vancouver, all higher than 15,000 ft., and Mt. Wrangell, 14,005 ft. (an active volcano), in the Wrangell mountains, Mt. St. Elias, 18,008 ft., and in Canadian territory, Mt. Logan, 19,850 ft. The Aleutian range, of which crest the Aleutian Islands are remnants, fills out the system near the coast. In the Aleutian range, near the base of the Alaska peninsula, there occurred in the early days of June 1912 one of the great volcanic eruptions of historic times. The top of Katmai, a mountain showing no evidence theretofore of volcanic action, was entirely blown off, and about the same time there came into existence in the valley to the northwest a vast number of tiny volcanic vents or fumaroles, later known as the Valley of Ten Thousand Smokes. The mountain and valley were later set apart by proclamation of the president (Sept. 24, 1918) as the Katmai National monument. The Alaska range, which lies south of the Yukon drainage system, connects with the Nutzotin and Skolai branches of the St. Elias range. It is splendidly marked by many snowy peaks, including Mt. Foraker (17,000 ft.) and Mt. McKinley (20,300 ft.), the loftiest peak in North America. North of the Yukon are the Baird and Endicott mountains of the Brooks range, an extension of the Rocky mountains. Between the Pacific mountains and the last-mentioned ranges lies the vast central plateau region or Yukon plateau. Finally, between the Brooks range and the Arctic ocean is the arctic slope region, a sloping plain corresponding somewhat to the interior plains of the United States.

The glaciers of the Panhandle and throughout the rest of the Pacific region are most remarkable—unusual alike for their number and size. Thousands of alpine glaciers from 1 to 15 mi. long fill the upper valleys and canyons of the mountains. Other glaciers are of the piedmont type. The two most notable glaciers are the Malaspina, largest in the territory, extending 50 mi. along the seaward base of Mt. St. Elias; and the Muir, at the head of the icy straits. The Muir was much visited by tourists prior to the earthquake in 1899, which so shattered the glacier and increased the discharge of ice that steamers no longer found it safe to approach near the face. The condition of the glaciers of Alaska, generally speaking, appears to be one of recession; many of them now have terminal moraines many miles back.




TWO SQUARES SHOWING THE RELATIVE AMOUNT OF SPACE AVAILABLE PER PERSON IN ALASKA (4.5 SQ. MI.) AND IN CONTINENTAL UNITED STATES (12.6 AC.)

Chief among the streams of Alaska is the Yukon, 1,800 mi. in length, which practically bisects the main peninsula. The principal feeders of this great river have their sources far away to the southeast in the coastal mountains along the boundary between Alaska, British Columbia and the Canadian Yukon territory. It flows in a general northwesterly direction for about one-half its length, passing through a small section of British Columbia and through territory of the Canadian Yukon till it reaches the 141st meridian. There it enters U.S. territory and, continuing to the northwestward, passes within the Arctic circle for a short distance in the vicinity of Port Yukon. It then turns southwesterly, gathering volume from many tributaries, the principal of which are the Tanana and the Koyukuk, and finally empties its flood into Bering sea through many mouths and over a vast bar, in longitude (approximately) 164° W. and latitude 63° N. The ocean port for the river, where merchandise is transferred by lighterage from ocean vessels to river boats, is a bay on St. Michael Island, lying about 60 mi. to the northeast of the Northern or Apoon mouth. River boats drawing from three and a half to four feet can enter the Apoon mouth and proceed without difficulty, in ordinary stages of water, practically the whole length of the river to Whitehorse, connecting there with the White pass and Yukon railway to Skagway. The period of navigation on the Yukon is from four to four and a half months. The second largest river in Alaska is the Kuskokwim, with its sources in the mountains of the Alaska range south of the Yukon drainage basin, and emptying into the Bering sea about 150 mi. S. of the mouth of the Yukon. It is navigable for about 600 mi. Out of the Alaska and Nutzotin mountains two great rivers flow southward: the Copper, practically unnavigable except for small boats, because of its turbulence and the discharge of glaciers into its waters; and the Susitna, also practically unnavigable. Both these rivers have their sources in lofty mountain masses, and are swift and powerful streams carrying with them much silt.

The Panhandle is remarkably picturesque. The maze of islands of the Alexander archipelago, hundreds in number, are remnants of a submerged mountain system; the islands rise 3,000 to 5,000 ft. above the sea, with luxuriantly wooded tops and bold, sheer sides scarred with marks of glacial action. Through the inner channels, sheltered from the Pacific by the island rampart, runs the "inland passage," the tourist route northward from Seattle, Wash. The interinsular straits are carried up into the mainland shore as fiords heading in rivers and glaciers. Most remarkable are the inlets known as Tracy Arm and Lynn canal (continuing Chatham strait). The first is very deep, with precipitous shores and bordering mountains 5,000 to 6,000 ft. high; the second is a noble fiord 100 mi. long and on an average 6 mi. wide, with magnificent alpine scenery.

Continental Alaska in the interior is essentially a vast plateau. "The traveller between the main drainage areas of the interior is struck by the uniform elevation. Rounded hills, level meads, and persistent flat-topped ridges, composed of rocks of varying

structure, rise to about the same level and give the impression that they are the remnants of a former continuous surface. In height it varies from about 5,000 ft. close to the bases of the mountain systems to less than 3,000 ft. in the vicinity of the main lines of drainage and slopes gradually toward the north."

**Geology.**—The outstanding features of Alaska are its mountain ranges, most of which consist of closely folded and contorted beds of sedimentary rock and underlying igneous masses, by intrusion of which the sedimentary beds were uplifted. A notable mountain chain is the Alaska range, which is nearly 600 mi. long and 50 to 80 mi. wide. This range, which was elevated to its present height late in Tertiary time, marks an old line of movement that has repeatedly been the site of folding and mountain building. In this range is the Mt. McKinley National Park, a reservation that contains 1,939,199.04 ac. and includes the highest peak in North America, Mt. McKinley, which stands 20,300ft. above sea-level. Volcanic products, which were poured out at intervals during an immensely long time, form a part of some ranges and make up most of the mass of many peaks. Among these volcanic peaks are the Wrangell mountains and many of the mountains on Alaska peninsula and in the Aleutian chain of islands. On the other hand, Mt. McKinley and Mt. St. Elias consist of masses of intruded granitic rock surrounded by sedimentary beds. The high relief of the larger mountain masses is due to their relatively recent elevation, the forces of erosion not yet having had time greatly to reduce their height.

The general outline of the mountain ranges in Alaska is a continuation of that seen in the region to the south, in Canada, but the course of the ranges in Alaska swings around from north-west to south-west, toward Asia, and the geologic history of the coastal ranges in both continents is doubtless similar. Far to the north lies Brooks range, from the northern base of which runs a series of gently folded beds that extend to the Arctic ocean.

The details of the geological structure and of the petrology of Alaska are extremely complex, and the attempt to trace the geological history of the region is very difficult. The geological record indicates a long series of periods of uplift and depression, of erosion and deposition, of folding and faulting and metamorphism of the beds deposited, and of intermittent volcanism that produced great areas of lava and ashes, which, like all other deposits, were shifted here and there and at some places greatly altered.

The oldest sedimentary deposits are certain pre-Cambrian rocks that lie in a broad belt in the upper Yukon valley, especially in the region between the Yukon and the Tanana, where they include what is called the Birch Creek schist, the bed rock in that region. The conditions and events in early Cambrian time are unknown, but in late Cambrian and in parts of Ordovician time large areas in Alaska appear to have been submerged, for most of the beds formed during those periods are marine deposits. Evidences of emergence, however, are found at some places. In early Devonian time there was a period of elevation, deformation, and subsidence over large areas. Toward the end of the Carboniferous period, in late Pennsylvanian or early Permian time, marine deposition prevailed, perhaps intermittently, until beds of limestone that measured in the aggregate thousands of feet in thickness were laid down over parts of Alaska. The Palaeozoic beds include at many places accumulations of volcanic material, but the greatest eruptions in Palaeozoic time appear to have occurred intermittently near its end, during the Pennsylvanian and Permian epochs. Most of the products of these eruptions lie south of the Alaska range. In late Permian and early and middle Triassic time Alaska was a land surface undergoing erosion. In late Triassic time depression again brought the sea over a large part of Alaska. This submergence was followed by widely extended uplift, which included probably all of Alaska. In early Jurassic time the Pacific and Arctic coasts were submerged and along them were deposited beds of sandstone, shale and limestone. Middle Jurassic deposits cover a somewhat wider area along the Pacific coast. In Jurassic time there was a persistent shore line near the site of the Alaska range.

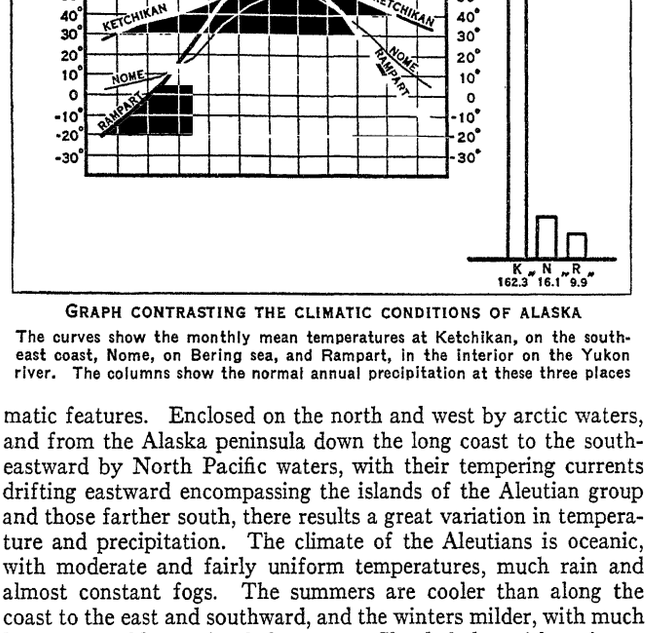
In early Cretaceous (lower Cretaceous) time renewed submergence brought the sea over much of Alaska, including parts of the Yukon valley, most of which had been above the sea since the end of Palaeozoic time. A large part of northern Alaska, which had been land since the end of the Triassic period, was also submerged. The deposits of this time include a basal conglomerate and overlying shale and limestone. An uplift and a change in places of sedimentation followed, in later Cretaceous (upper Cretaceous) time, during which the larger topographic features of present Alaska were doubtless outlined. Marine deposits were laid down along the Arctic and Pacific coasts and in the lower and broader parts of the Yukon and probably other valleys. Terrestrial deposits were formed in embayments that stood on the sites of the larger river valleys. The submergence of the Yukon valley gradually increased and as gradually slackened, and swamps were formed in which plants grew and coal beds were laid down. The Cretaceous deposits in the Kuskokwim valley appears to be very similar to those in the lower Yukon valley. While sedimentation was in progress in the Yukon valley the rest of Alaska may have been land. During later Cretaceous time the sea invaded the sites of the Matanuska and Chitina valleys and parts of the southern coastal region. The deposits of this time in Alaska peninsula include marine shale, coal-bearing shale, conglomerate sandstone and shale, probably of mixed marine and terrestrial origin. The end of Cretaceous time on Alaska peninsula appears to have been marked by a period of mountain growth. The Cretaceous beds are greatly folded everywhere and many of them are cut by intrusive rocks and intrusive veins. Deposits of tuff laid down in early Tertiary (Eocene) time show that the diastrophic movements which began late in Cretaceous time culminated in volcanic eruptions. Among the earliest post-Cretaceous deposits are the Tertiary coal-bearing beds. Two groups of coal beds that lie near the Alaska range are reached by the Alaska Railroad, one in the valley of Matanuska river, in lat. 61° 45′, the other along and east of the Nenana river, about lat. 64°. Most of the coal mined is used on the railroad. Beds of lignitic coal are exposed at many places around Cook Inlet and in the lower part of the valley of the Susitna river. The coal-bearing beds, which have been at some places greatly tilted and folded, generally consist of poorly consolidated sand, clay and gravel, and at some places contain abundant remains of plants. Many of the Tertiary rocks, however, consist of hard conglomerate and shale, and include basaltic lava and other volcanic material, as well as intrusive dikes and sills.

By early Quaternary time the great mountain-building movements in the south of the Alaska range had apparently ceased and the larger topographic features of this region, including the Kenai-Chugatch range, the Talkeetna Mountains and the Yukon-Tanana upland, had assumed nearly their present form, although the details of the drainage may have been different, for the climate was milder than it is now. A colder age followed, in which enormous glaciers were formed in the mountains. The Quaternary beds, which include glacial deposits, are widespread. In the Alaska range and in the region south of it such deposits constitute a large part of the unconsolidated surface material. The glaciers abraded the rocks of the highlands and carried down into the lowlands immense quantities of gravel, sand, silt and till, modifying the forms of the higher valleys and leaving thick deposits over large areas. The bluffs along Copper river, for example, consist of glacial deposits more than 500 ft. thick; and moraines, outwash gravel and thick delta fans made up of glacial material cover large areas. The glaciers now appear to be receding, but the deposition of outwash from glaciers is still in active progress at many places, and the great glaciers in the Alaska range and the Wrangell mountains, and especially the glaciers of Kenai Peninsula, Prince William Sound and the coast farther south, are conspicuous features. The higher parts of the Alaska range are the gathering grounds for some of the largest valley glaciers Five or more of these great tongues of ice are from 2 to 4 mi. wide and 30 to 50 mi. long. The present surface form of the mountains of this range has been produced in large part by the erosive action of these glaciers and of their much larger predecessors.

Great changes in the climate of north-western North America are indicated by the fossil plants. The flora of Alaska was at times evidently that of a temperate or a warmer region.

The uplifts in Alaska apparently established land connection between North America and Asia at several periods. Across this body of land in Tertiary time horses of early types passed to Asia from the central plains of North America, which appear to have been the first habitat of the horse. Early elephants, or elephant-like creatures, on the other hand, found their way from Asia to America, where their remains have been discovered at many places.

**Climate.**—Alaska is one of the "ends of the earth" and as such presents many interesting extremes, none more than in its climatic features. Enclosed on the north and west by arctic waters, and from the Alaska peninsula down the long coast to the southeastward by North Pacific waters, with their tempering currents drifting eastward encompassing the islands of the Aleutian group and those farther south, there results a great variation in temperature and precipitation. The climate of the Aleutians is oceanic, with moderate and fairly uniform temperatures, much rain and almost constant fogs. The summers are cooler than along the coast to the east and southward, and the winters milder, with much less snow, seldom going below zero. Clouds laden with moisture from the warm Pacific currents, being swept in upon the mountains and the many glaciers by the prevailing winds, produce a heavy precipitation of rain in summer and snow in winter. Across the coast range in the interior there is an entirely different climate. There the precipitation, of both rain and snow, is comparatively light except upon the high mountain ranges. Low temperatures occur in winter—occasionally as low as −75° or −80° F.—with short, hot summers. In this part of Alaska the ground is permanently frozen to great depth in most of the valleys, but on the drier hillside slopes it frequently happens that but little frost is found. The tempering influence of the ocean currents practically disappears north of the line of the Pribilof Islands, or about the middle of Bering sea, and the regions to the northward and eastward of this are for the most part barren, windswept and inhospitable. Arctic conditions prevail, especially beyond Bering strait. Point Barrow, farthest north (71° plus), is ice-locked for about ten months of the year.




GRAPH CONTRASTING THE CLIMATIC CONDITIONS OF ALASKA

The curves show the monthly mean temperatures at Ketchikan, on the southeast coast, Nome, on Bering sea, and Rampart, in the interior on the Yukon river. The columns show the normal annual precipitation at these three places

**Fauna and Flora.**—The fauna of Alaska is very rich and surprisingly varied. The lists of insects, birds and mammals are especially noteworthy. Of these three classes, and of other than purely zoological interest, are mosquitoes, which swarm in summer in the interior in vast numbers; seafowl, which are remarkably abundant near the Aleutians; moose, and especially caribou, which in the past were very numerous in the interior and were of economic importance to the natives. The destruction of the wild-life threatened to expose the Eskimos to starvation, hence the effort made by the United States government to stock western Alaska with domestic reindeer from Siberia. It is, however, the fish and fur-bearing animals of its rivers and surrounding seas that are economically most distinctive of and important to Alaska. The fishing grounds extend along the coast from the extreme southeast past the Aleutians into Bristol bay.

Herring, cod and salmon abound in almost incredible numbers. Of marine mammals, whales are hunted far to the north in Bering sea and the Arctic ocean, but are much less common than formerly as are also the walrus, the sea otter and the sea lion. Fur seals are increasing in number because of effective government control. The number of fur-bearing land animals is equally large. Sable, ermine, wolverine, mink, land otter, beaver and muskrat have always been important items in the fur trade. There are black, grizzly and polar bears and also two exclusively Alaskan species, the Kodiak (or Kadiak) and the glacier bear. The gray wolf is common; it is the basal stock of the Alaskan sledge dog. The red fox is widely distributed, and the white or arctic fox is very common along the eastern coast of Bering sea. A blue fox, once wild, is now domesticated on Kodiak, the Aleutians and the southern continental coast, and a black fox, very rare, is found in southeastern Alaska. The silver fox is very rare.

The Alaskan flora is no less varied than the fauna. Wildflowers are alpine in size, colour and profusion. The forests of the coastal region, though hitherto almost unutilized, are of potential value. The balsam fir and in the south the red cedar are found in scant numbers; more widely distributed, but growing only under marked local conditions, is the yellow or Alaska cedar, a very hard and durable wood of fine grain and pleasant odour. Far the most abundant are coast and alpine hemlocks and the tideland or Sitka spruce. The spruce is not confined to this part of Alaska, but is the characteristic and universal tree. The separation of the coast and interior flora is almost complete; only along the mountain passes and river valleys, and rarely there, is there any change of species. Timber, however, is fairly abundant along the entire course of the Yukon above Anvik (about 400 mi. from the mouth), along the great tributaries of the Yukon and along every stream in central Alaska. The woods of the interior consist almost entirely of spruce. On the Yukon flats it grows in a vast forest impenetrably dense. The timber line, which in the Panhandle and along the southern coast of the continental mass runs from 1,800 to 2,400 ft., frequently rises in the interior plateau even to 4,000 ft. Next in importance after spruce in the interior is birch and then balsam poplar. Thickets of alders and willows in wet places and new-made land, aspens and large cottonwoods west of the characteristic spruce area (as on Seward peninsula) are also common. Toward the Arctic circle the timber becomes, of course, sparse, low, gnarled and distorted. The willows in the arctic drainage basin shrink to shrubs scarcely knee-high. Grasses grow luxuriantly in the river bottom and wherever the tundra moss is destroyed to give them footing. Most distinctive is the ubiquitous carpeting of mosses, varying in colours from the pure white and cream of the reindeer moss to the deep green and brown of the peat moss, all conspicuously spangled in the brief summer with bright flowers of the higher orders, heavy blossoms on stunted stalks.

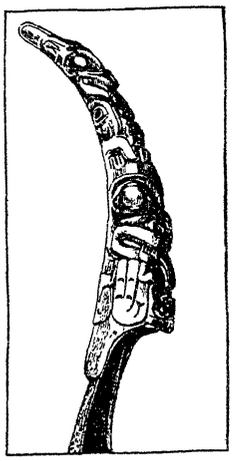
Sedges available for forage grow in the tundra. In August berries are fairly abundant over the interior; one of them, the salmonberry or cloudberry, preserved in seal oil for the winter, is an important food of the natives. The western timber limit is on Kodiak Island. The Aleutian Islands are almost destitute of trees, but are covered with a luxuriant growth of herbage. Climatic differences cannot account for the treeless condition of the country west of this point, and the true explanation lies probably in the fact that in winter, when the seeds of the coastal forests ripen and are released, the prevalent winds west of Kodiak are damp and blow from the south and southwest, while the spread of the seeds requires dry winds blowing from the north and northwest. Such favourable conditions occur only rarely.

**Exploration and Early History.**—In the early explorations of the northwest coast of America, Spain was first in the field but there is little evidence to prove that any Spanish navigator sailed as far north as Alaska. Later, and during the period of active Russian exploration, a number of expeditions were sent north from Mexico and at one time Spain claimed the sole right

to navigate the waters of the northern Pacific and issued a prohibition against other nations trading in those waters. Many Spanish names of places along the coast remain today to attest the extent of these explorations. Spain does not appear to have pressed her claims, however, and gradually ceased her efforts in this direction. This may have been because of disputes on her hands in other parts of the world or the wide extent at that time of the Spanish claims in the western hemisphere or possibly, in part, the fact that the climatic conditions of this northern region did not appeal strongly to a people whose life and activities had been spent in warmer climes. To the Russian, on the other hand, these regions were as home.

During the latter half of the 17th century the Russians had been pushing their explorations across Siberia and along the eastern and northern shores of Asia. In 1728 Vitus Bering passed through the strait named after him and Girosdeff sighted the American coast in 1731. Bering's second expedition, in company with Alexei Chirikov, sailed from the Siberian coast in 1741. The mainland of America was located and numerous islands visited. This expedition is commonly accepted as fixing the date of the discovery of Alaska. Bering's ship was wrecked in early November on what is now called Bering Island. The crew made such provision as was possible against the cold of the approaching winter, but the privations and hardships were very great. "It was under such circumstances that Vitus Bering died—on this cold, forbidding isle, under the sky of an Arctic winter, December 8, 1741." During the 30 or 35 years following, the Russians were active in exploring the coast and islands and in establishing a trade with the natives.

About the time the American colonies were making their struggle for separation from the mother country, England was beginning her part of the exploration of this northwest coast. Three names stand high in the record of these explorations: James Cook, George Vancouver and Sir Alexander Mackenzie. Cook's expedition sailed from England in July 1776. In the personnel of his expedition were men from the American colonies, and Vancouver, then a midshipman, was of the party. The work begun by Cook was continued by Vancouver during the years 1791 to 1794. W. H. Dall expressed the view generally held concerning Vancouver's work in the statement that: "The explorations which he carried out have not been excelled by any other navigator and were faithfully and thoroughly performed." The Hudson's Bay company was meanwhile advancing its trade and extending its influence westward from the interior of Canada. In 1793 Mackenzie crossed the continent by land to the Gulf of Georgia, returning by the same route. This expedition, although little known, may well be compared with that of Meriwether Lewis and William Clark, in respect both of the difficulties encountered and of its value to his company and government.



BY COURTESY OF AMERICAN MUSEUM OF NATURAL HISTORY

CARVED WOODEN SPOON USED BY THE INDIANS OF ALASKA

The excesses committed by private traders and companies, who robbed, massacred and hideously abused the native Indians, caused the Russian government in 1799 to confine the trade and regulation of its American possessions to a semiofficial corporation called the Russian-American company for a term of 20 years, afterward twice renewed for similar periods. Alexander Baranof, chief resident director of the American companies (1790–1819), and one of the administrators of the new company, became famous through the success he achieved as governor. He founded Sitka (*q.v.*) in 1804 after the massacre by the natives of the inhabitants of an earlier settlement (1799) at an adjacent point. The headquarters of the company were at Kodiak until 1805, and thereafter at Sitka.

In 1821 Russia attempted by ukase to exclude navigators from Bering sea and the Pacific coast of her possessions. This led to immediate protest from the United States and Great Britain. The outcome was a treaty with the United States in 1824 and one with Great Britain in 1825, by which the excessive demands of Russia were relinquished and the boundaries of the Russian possessions were established. In the convention with Great Britain, it was agreed that Russia should have the narrow strip of coast north of 54° 40′ and the peninsula and islands westward of the 141st meridian.

The last charter of the Russian-American company expired on Dec. 31, 1861, and Prince Maksutov, an imperial governor, was appointed to administer the affairs of the territory. Authority was granted to an American company in 1864 to make explorations for a proposed Russo-American company's telegraph line overland from the Amur river in Siberia to Bering strait, and through Alaska to British Columbia.

Work was begun on this scheme in 1865 and continued for nearly three years, when the success of the Atlantic cable rendered the construction of the line unnecessary and it was given up, but not until important explorations had been made. Much of this information was made public in 1870 by W. H. Dall in his book *Alaska and its Resources.*

The first official overtures by the United States for the purchase of Russian America were made by Sen. William Gwin of California (1859) during the presidency of James Buchanan. This movement, however, was checked temporarily by the Civil War, which soon followed.

The fishing interests of northwestern United States were next to manifest an interest in the territory to the northward. In 1866 a memorial was adopted by the legislature of the Washington territory, "in reference to the cod and other fisheries," and delivered to Pres. Andrew Johnson. By a treaty signed on March 30, 1867, the purchase was consummated for the sum of $7,200,000, and on Oct. 18, 1867, the formal transfer of the territory was made at Sitka.

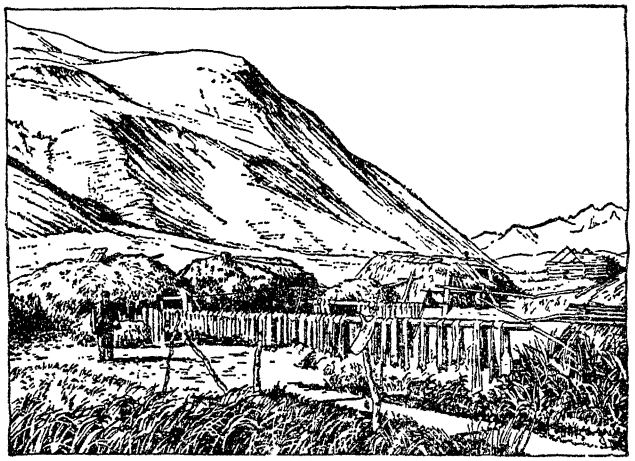
**Later History.**—After its acquisition by the United States, the history of Alaska was mainly that of the evolution of its administrative system and the varying fortunes of its gold fields, fisheries and sealing industries. Alaska was an unorganized territory from 1867 until May 1884. From 1867–77 the government was in the hands of the department of war, although the customs were from the beginning collected by the treasury, with which the control rested from 1877 until the passage of the so-called Organic act of May 17, 1884. This act extended over Alaska the laws of the state of Oregon so far as they should be applicable, created a judicial district and a land district, put in force the mining laws of the United States and in general gave the administrative system the organization it retained up to the reforms of 1899 and 1900. The history of government and political agitation then centred in the demand for general land legislation and for an adequate civil and criminal law, in protest against the enforcement of a liquor prohibition act, and in agitation for an efficiently centralized administration. After partial and inadequate legislation from 1891 to 1898, the regular system of land surveys was made applicable to Alaska in 1899, and a generous homestead law was provided in 1903. The liberal land policy was completely reversed as a result of the conservation movement inaugurated under Pres. Theodore Roosevelt. The original aim of the movement was to prevent waste of natural resources, but this gradually veered to a protest against corporate control of lands and resources.

An important result of the conservation movement was the increase of reservations in Alaska, about 40,000 sq.mi. being set aside for various purposes, exclusive of mineral and forest withdrawals. For many years, however, the conservation issue remained unsettled and industry languished; with an abundant supply of fuel close at hand, Alaska was forced to import petroleum and coal at great cost; her pulp wood was rotting in the forests; her water power was undeveloped. Only gold and copper mining and salmon fishing increased. Finally during the Woodrow Wilson administration, a leasing policy for coal and oil lands and water power was established by law.

The struggle of Alaska to attain representation at Washington,

D.C., resulted in 1906 in the authorization of an elected delegate to congress. At each biennial election which followed, home rule was the only important issue, until in 1912 an act was passed granting a limited territorial government. The first territorial legislature was convened at Juneau on March 3, 1913, and the first law passed gave the franchise to women.

The agitation over prohibition dated from 1868; the act of that year organizing a customs district forbade the importation and sale of firearms, ammunition and distilled spirits; the Organic act of 1884 extended this prohibition to all intoxicating liquors. Smuggling flourished; juries steadily refused to convict offenders and treasury officials regularly collected revenue from saloons existing in defiance of law. In 1900 the sale of liquors was authorized under a high licence law. In 1917 congress responded to a legislative petition by passing a dry law for Alaska. In 1940 the people of Alaska rejected territorial liquor control by referendum.



BY COURTESY OF THE FISH AND WILD . FE SERVICE, DEPT. OF INTERIOR

**NATIVE METHOD OF DRYING SALMON EMPLOYED IN WESTERN ALASKA**
In summer the Alaskan Indian catches a great quantity of salmon, which is hung over poles to dry and then stored for the winter months

Two events of international interest growing out of Alaska were the fur seal arbitration of 1893 (*see* BERING SEA ARBITRATION), and the Alaskan-Canadian boundary dispute, previously mentioned, settled by an international tribunal of British and American jurists in London in 1903. The boundary dispute involved the interpretation of the words in the treaties of 1825 and 1867 defining the boundary of the Russian (later U.S.) possessions, and also the determining ownership of the Portland canal and the question whether the coastal girdle should cross or pass around the heads of the fjords of the coast. The award of the tribunal made in Oct. 1903 was arrived at by the favourable vote of the three commissioners of the United States and of Lord Alverstone, whose action was bitterly resented by the two Canadian commissioners; it sustained in the main the claims of the United States.

Very little was known about the interior of Alaska previous to 1896, when the gold discoveries in the Klondike stimulated public interest regarding it. From 1895, however, explorations of the United States geological survey and the department of war, as well as those of individuals, established the main features of its physiography and a rather accurate knowledge of its resources.

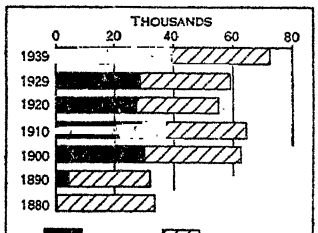
The federal government began to expand its military establishment in the territory in 1939, after belatedly recognizing the strategic importance of Alaska as a northerly and westerly outpost in the nation's defense system. Throughout World War II Alaska was a vitally important link in the new air routes to the U.S.S.R. During the conflict, this northwestern province, extending from a point 700 mi. N. of Seattle to within sight of the mainland of far eastern Russia, entered increasingly into U.S. national consciousness as the struggle progressed—first, as the objective of Japanese aggression, next, as an important take-off point for attacking Japan, and finally, with peace, as a new frontier for war veterans. Many new airports were constructed throughout Alaska and the first land link between the territory and the continental United States was completed with construction of the Alaska highway. Vast military expenditures, plus scores of new service industries resulted in substantial increase in the economic levels of almost all regions of the territory; there was no mass exodus of population from Alaska at the war's end.

Accompanying the economic progress was considerable political progress. Alaskans in 1946 voiced their demand for statehood at the ballot box. The appeal for statehood was by no means a new desire, as numerous bills had been introduced in the congress of the United States calling for statehood for Alaska during the preceding years. Backed by the results of the 1946 referendum, Alaska's delegate to congress introduced another bill for Alaska statehood and for the first time congressional hearings were held on the subject. During 1947 and 1948, hearings were held both in Alaska and Washington, D.C. On April 14, 1948, the house committee on public lands reported favourably on a bill to provide for admission of Alaska to the union. The measure, however, did not reach the floor of the house. During the first session of the 81st congress, 1949, the measure again received approval of the committee, and again failed to reach the house for action. It was not until the second session that the house of representatives passed the statehood measure. The senate, however, did not act on the bill during its regular session.

**Population.**—The population in 1867, at the time of the cession from Russia, was estimated at 30,000, made up mainly of Eskimos and other natives. The population in 1880, at the time of the first enumeration by the United States, was 33,426, which number included only a few hundred white persons: in 1900 it was 63,592 and in 1910, 64,356, while in 1920, partly by reason of the decline in the gold-mining industry, the census recorded only 55,036. In the next census (1929), the population was 59,278; in the 1939 census, 72,524—the latter figure representing an increase of 22.3% over 1929. Of this number, 30,384 were native whites, 8,786 were foreign-born whites and 33,354 were nonwhites, mainly persons of native stock. Of the 8,786 foreign-born whites, 2,444 were born in Norway, 1,223 in Sweden, 1,051 in Canada, 665 in Finland and 589 in Germany. No other country contributed as many as 400. Of the 33,354 nonwhite persons, 32,458 were of native stock, comprising 15,576 Eskimos, 5,599 Aleuts and 11,283 Indians.

According to the 1950 census, taken as of April 1, there were 128,643 persons in Alaska, representing an increase of 77.4% over the previous census count, and the largest increase, percentage-wise, of any state or territory. A substantially larger increase would have been recorded but for the almost absolute lack of housing facilities to accommodate those who were desirous of settling in Alaska, many of whom gave up their plans on finding it impossible to secure residential accommodations, and returned to the states

In the native white population there were 18,651 males and only 11,733 females, making a sex ratio of 159.0 males per 100 females. The foreign-born white population was even more dominantly male, there being 377 males per 100 females. In the native white population, 5.9% were 65 years old or over; in the foreign-born white, 9.3%; and in the native stock, 2.9%. There were 28,936 employed persons 14 years old or over in the labour force in 1939, of whom 5,061 were engaged in agriculture and trapping (mainly in hunting and trapping), 3,207 in fishing, 4,997 in mining, 4,630 in manufacturing and construction, 4,290 in transportation and trade, and 1,677 in professional and related services. In June, July and August of 1939, however, more than 10,000 persons, largely seasonal workers from the states, were employed in the canning industry.




COURTESY OF U.S. CENSUS BUREAU

**POPULATION: 1880-1939**

The towns of Alaska are all small but they are centres for busi-

ness and social activities, as well as for government agencies, each serving a wide tributary area, and are therefore relatively more important than towns of similar size in more populous regions. The population of the territory and its principal cities and incorporated towns is summarized in the accompanying table.

| Area | Population | | | Per cent of increase | |
|---|---|---|---|---|---|
| | 1950 (April 1) | 1939 (Oct. 1) | 1929 (Oct. 1) | 1939–50 | 1929–39 |
| The territory | 128,643 | 72,524 | 59,278 | 77.4 | 22.3 |
| Urban* | 27,705 | 17,374 | 7,749 | 59.5 | 24.2 |
| Rural | 100,938 | 55,150 | 51,529 | 83.0 | 7.0 |
| Per cent urban | 21.5 | 24.0 | 13.1 | — | — |
| Principal cities:† | | | | | |
| Anchorage | 11,060 | 3,495 | 2,277 | 216.5 | 53.5 |
| Juneau | 5,818 | 5,729 | 4,043 | 1.6 | 41.7 |
| Fairbanks | 5,625 | 3,455 | 2,101 | 62.8 | 64.4 |
| Ketchikan | 5,202 | 4,695 | 3,796 | 10.8 | 23.7 |
| Sitka | 2,080 | 1,987 | 1,056 | 4.7 | 88.2 |
| Seward | 2,063 | 949 | 835 | 117.4 | 13.5 |
| Nome | 1,852 | 1,559 | 1,213 | 18.8 | 28.5 |
| Kodiak | 1,635 | 864 | 442 | 89.2 | 95.4 |
| Petersburg | 1,605 | 1,323 | 1,252 | 21.3 | 5.7 |
| Wrangell | 1,227 | 1,162 | 948 | 5.6 | 22.6 |

*Population of cities and towns having 2,500 inhabitants or more; 1950 data preliminary.
†Figures for 1950 based on a preliminary, but approximately complete, count of the census returns.

**Government.**—Alaska's first legislature, which met in 1913 and was patterned after the Washington Territorial act of 1853, consisted of 8 senators and 16 representatives elected from the territory's four judicial divisions. In 1950 the Alaska territorial legislature consisted of 4 senators from each of the four judicial divisions elected to four-year terms and 24 representatives, apportioned in proportion to population, elected to two-year terms, the representation being eight, seven, five and four from the first, third, fourth and second divisions respectively. The members' salaries and transportation to and from the legislative sessions are paid by the federal government. The legislature convenes biennially in odd years for a period not to exceed 60 days, to legislate on territorial matters, not specifically prohibited by the Organic act, adopt a biennial budget and pass on the governor's appointments. The governor is empowered when the need arises to call a special session which may not continue longer than 30 days.

The actual government of Alaska is both federal and territorial. Both the governor and secretary of Alaska are appointed for four-year terms by the president of the United States, the former subject to confirmation by the United States senate. In the governor's absence from the territory, the secretary is acting governor. In some instances the federal and territorial functions overlap; in others they are separate and distinct.

There are four judicial divisions in Alaska with headquarters at Juneau, Nome, Anchorage and Fairbanks. A federal district judge, United States attorney and United States marshal—all presidentially appointed—preside over each. In addition to their judicial duties, the judges issue liquor licences and dispense a small fund for indigents. They likewise appoint the United States commissioners, of whom there were 53 in 1949. The commissioners act as local court magistrates, probate judges and coroners, are unsalaried but paid through a variety of fees. There are no territorial courts. The commissioner's courts have jurisdiction in probate, insanity and minor civil and criminal matters arising under the federal statutes applicable to the territory under territorial laws. Additionally, each incorporated municipality has a magistrate court which has jurisdiction over matters arising under local ordinances. The district courts have the same general original jurisdiction as similar courts in the continental United States, having in addition general jurisdiction in civil, criminal, equity and admiralty cases. Prior to 1947 the marshal's office had the sole responsibility for the maintenance of law and order outside of incorporated towns. In 1947 members of the Alaska highway patrol, a territorial police force, were given full police powers and the authority of the United States marshal. They also were appointed deputy game wardens.

Among the various federal departments operating in Alaska are the department of interior, department of agriculture, department of commerce, department of labour and the treasury department. Other executive departments of the federal government exercise the same administration respectively in Alaska that they do in other parts of the United States, and virtually every executive branch of the government was represented by mid-20th century.

The principal territorial officers are the attorney general, treasurer, auditor, highway engineer and commissioner of labour, all nominated in party primaries and elected by popular vote for four-year terms. These officials, together with a commissioner of education and the governor, constitute the board of administration which exercises limited administrative functions between legislative sessions. Other territorial officials, such as the commissioners of agriculture, mines and taxation, are appointed by the governor and subject to confirmation by the legislature. Alaska elects its delegate to the federal congress for a two-year term. He represents the territory, is a member of a number of committees in the house of representatives and can speak on the floor as well as introduce bills, but has no vote. The political parties of Alaska send delegates to national conventions where candidates for president and vice-president of the United States are nominated, but Alaska has no vote in the electoral college. All citizens of Alaska—whites, Indians, Aleuts and Eskimos—have the right to vote and in the 1950 election two Eskimos were elected to the senate and two Indians and one Eskimo to the house. The principal territorial agencies are the department of education, department of health, department of public welfare, department of mines, department of agriculture, Alaska veterans affairs commission, department of fisheries, department of aviation and Alaska development board. The latter agency, created by the territorial legislature in 1945, directs most of its activities in behalf of new and expanded industrial and business enterprises in Alaska.

**Finances.**—The budget for the 1951–53 biennium, exclusive of expenditures for roads, waterfront improvements and airfields, which are financed out of fuel tax receipts, was $17,973,645, the major items of which were $8,077,688 for education, $2,896,000 for welfare, and $999,000 for health. The governor can veto bills and any specific item in the appropriation bill, but may be overridden by a two-thirds vote of the two houses polling separately.

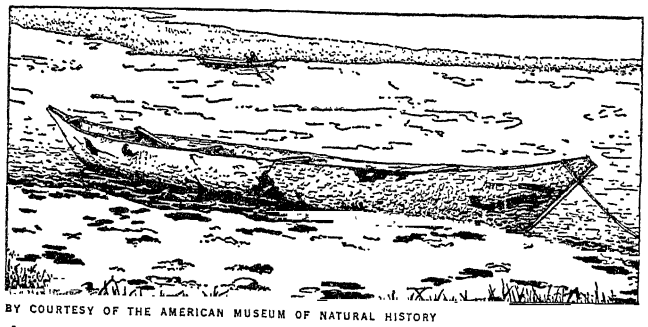
The fiscal system of the territory underwent a pronounced change at the 1949 session of the territorial legislature. The old licence statute enacted by congress in 1899 and 1900, under which the federal government collected licence fees on certain occupations, professions and lines of business and through the Alaska fund turned them over to the territory, was repealed by an act of congress. The legislature enacted a number of revenue statutes including an income tax on persons and corporations, a business licence tax on occupations, professions and various lines of business, a definite percentage tax on the sale of canned salmon, a raw fish tax, a resident and nonresident fisherman's licence tax, a tax on tobacco and tobacco products, a motor-fuel tax, a graduated tax on fish traps, a tax on automobiles and on drivers and a general property tax. These, together with the old tax on liquor and school tax, constituted the principal source of territorial revenue. For the fiscal year ending June 30, 1950, the department of taxation collected a gross total of $9,232,421.06.

There were 17 territorial and 4 national banks operating in Alaska on June 30, 1950, with a combined capital of $1,505,000, surplus and undivided profits of $3,572,914.62 and total deposits of $78,103,948.91.

**Education and Welfare.**—By an amendment to the Organic act passed in 1917, Alaska became responsible for the education of its white population. The Alaska division of the office of Indian affairs, department of the interior, is required to provide for the education of the natives, to train them in industry and to furnish them medical relief. The enrolment in the territorial schools for the session 1949–50 was 13,908 pupils and 544 teachers. Of the total enrolment, 2,418 were in high schools and 11,490 in elementary schools. The school term in incorporated towns ranged from nine to ten months and for rural districts from seven to nine months. During the fiscal year 1950 there were 4,082 natives in the 83 schools supported by the federal government. There were in addition 902 students attending 16 parochial schools. The only

institution of higher education is the land-grant University of Alaska opened at Fairbanks in 1922. Its enrolment for 1949–50 was 509 and 972 were registered in short courses.

The burden of welfare falls on both the territorial and federal governments. The insane of Alaska are cared for at federal expense in a private institution.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

A DUGOUT CANOE OF THE TLINGIT INDIAN, A MEMBER OF ONE OF THE FOUR ETHNOLOGICAL RACES IN ALASKA. THE TLINGIT ARE SKILLED FISHERMEN AND HUNTERS, WHO FASHION THEIR CANOES FROM CEDAR LOGS. THE CRAFT VARY IN SIZE AND SHAPE ACCORDING TO PURPOSE. THE TYPE ABOVE IS USED ON INTERIOR WATERS

**Fisheries.**—The product of the fisheries is about equal to the sum total of all other Alaskan products. The total value of fish marketed between 1867 and 1949 was $1,930,112,109. In 1949 Alaskan fisheries employed about 33,000 people. The total value of Alaskan fishery products in 1949 was $98,904,063, a decrease of $58,799,570 from 1939.

The pack of canned salmon in 1949 was 4,391,051 cases. Halibut products in 1949 were valued at $4,800,000, an increase of more than $4,300,000 over 1939. Operators of this particular fishing industry are governed by a voluntary production-control program and by regulations of the International Fisheries commission. Despite the existence of cod-fishing banks from 22 to 90 fm. deep in the Bering sea and east of the Alaska peninsula, little has been done to exploit the enormous cod resources. Whale fishing was suspended during World War II and had not yet been resumed in 1950 because of various economic factors.

Crab, clams and shrimp assumed an important position in Alaska's canning and packing industry. Utilization of fish waste in the production of fish meal, oils and fertilizer also is important. The total value of these products in 1949 was $2,364,966.

**Agriculture and Livestock.**—In 1950 the best-developed farming areas were in the Matanuska and Tanana valleys where vegetables and poultry were being raised in unprecedented quantities. There is an abundance of good grazing land in the interior, but the period of winter feeding is about eight months.

The Matanuska valley had proved particularly adapted for breeding dairy cattle. The domesticated reindeer herds in 1949 were estimated at 30,000 head, a reduction of 220,000 during the past ten years. It is estimated that Alaska contains 256,000,000 ac. suitable for grazing of reindeer and capable of supporting 10,000,000 deer.

This industry, however, promises little for the future of Alaska except insofar as it may contribute to the sustenance of the Eskimos.

**Furs.**—Between 1867 and 1949 Alaska produced furs to the value of about $192,500,000, of which about 55% represented sealskins taken on the Pribilof Islands. Value of furs shipped from Alaska to the United States during 1949 was $2,075,547, exclusive of sealskins from the Pribilof Islands. Up to 1910 the government leased the seal-catching privileges on these islands to private corporations, which killed 2,320,028 seals and paid the government $9,474,000 in royalties. The land killing of seal was restricted, but pelagic sealing, which was becoming very destructive, could not be controlled by the U.S. government; a treaty was therefore signed in 1911 between the United States, Great Britain, Russia and Japan, abolishing pelagic sealing and providing that the United States was to pay to both Great Britain and Japan 15% of the value of the catch made on the islands. From 1910 killing was prohibited on the Pribilof Islands, except by U.S. agents.

Thanks to these provisions the seal herd increased from 215,000 in 1912 to 3,837,131 in 1949. In 1949, 70,142 sealskins were taken from the herd.

**Minerals.**—As early as 1861 gold discoveries were made on the Stikine river; repeated discoveries, culminating in the Cassiar district "boom," were made in British Columbia from 1857 to 1874; colourings along the Yukon were reported in 1866–67 and systematic prospecting of the upper river began about 1873. Juneau was founded in 1880; the same year the opposition of the Indians, which prevented the crossing of the mountain passes to the interior, was withdrawn, and after 1880 repeated and scattered discoveries were made on the Lewes, Pelly, Stewart and other streams of the upper Yukon country in Canada. As early as 1883–85 there was a considerable mining excitement caused by these discoveries, and a much greater one in 1887 after the discovery of coarse gold on Forty Mile creek in U.S. territory; but these were as nothing to the picturesque and feverish rush that followed the location of the first Klondike claim in Canadian territory in Aug. 1896.

The total value of the mineral output of the territory from 1880 through 1949 was approximately $975,000,000. Of this $535,936,000 was for gold, $227,408,400 for copper and $13,622,000 for silver. Alaska also produces coal, lead, tin, platinum, palladium, antimony, tungsten, natural gas, petroleum, marble, gypsum, graphite, barite and sulphur. Copper mining, begun in 1901, was the chief mineral industry for many years, but in 1930 production of that ore began to fall rapidly at the same time gold production expanded. Thus, while the value of the two was close in 1928, the gold output of 1949 was $8,029,560, as compared with a copper production of but $1,576. Coal, both bituminous and anthracite, occurs in the Bering river and the Matanuska fields, which lie within reach of the government railway. The territory also contains an abundant supply of subbituminous and lignite coals, which are widely distributed. The production up to and including 1949 had a value of $31,626,567 with the output for that year standing at 430,000 tons worth $2,205,900.

Important oil seepages were found at five places on the Pacific seaboard, and at two places in the naval petroleum reserve no. 4 on the north Arctic coast. The withdrawal of all oil lands from entry in 1911 stopped development until 1919, when an oil-leasing law was passed and operations begun in several localities. The production of petroleum, however, was confined to the Katalla field; and when a fire destroyed that refinery in 1933 production was entirely discontinued. The U.S. navy at mid-century was exploring the Arctic field. About 16,500,000 oz. of silver and 18,000 tons of lead had been produced. Almost all the tin output of North America comes from Alaska, chiefly from the York district in the Seward peninsula. The mining of platinum and related minerals began in 1916. Although platinum mining operations expanded during and after World War II, production figures were not announced. Quicksilver mining is carried on in a small way, and in southeastern Alaska high-grade marble is quarried.

**Timber Production.**—The commercial timber of Alaska is contained in the two great national forests, the Tongass in southeastern Alaska and the Chugach on Prince William sound. They had, in 1940, a total area of 20,878,000 ac., and are estimated to contain 84,000,000,000 bd.ft. of saw timber, of which 73% is western hemlock and 20% Sitka spruce. The remainder is largely western red cedar and Alaskan cedar.

Volume of timber cut in 1949 was 56,000,000 bd.ft.; the stumpage value was $114,056.

**Communication and Transportation.**—All commercial communication channels between the territory and the continental United States are operated and maintained by the Alaska Communications system, a branch of the United States army signal corps. Telephone and telegraph services are handled over landlines, cable lines and radio channels. Established in 1900, the Alaska Communications system at mid-century was operating 14 main and 18 substations in Alaska serving military, federal and territorial government agencies and the general public. Total cash receipts for the fiscal year ending June 30, 1950, amounted to

$1,102,213.15. An extensive system of radiotelephone stations in isolated communities was established by the Alaska Communications commission, an agency of the territorial government. The Alaska native service operated a total of 102 radiotelephone stations in 1950, the majority located in the arctic regions. There were 14 community telephone exchanges in Alaska with a total of 11,763 instruments.

There were six daily, nine weekly, one bi-weekly and two tri-weekly newspapers published in the territory in 1950, and ten radio broadcasting stations were in operation.

Lack of adequate land transportation routes between Alaska and the United States had a profound effect on the territory's development. The ruts of the oxcart and the covered wagon, the rails and ties flung across the American frontier, were forerunners of development in the western states, but it was many years after much of the early pioneering had been accomplished that transportation routes—highways and railways—were developed in Alaska. Two United States and three Canadian steamship companies regularly serve Alaska as common carriers. In addition several concerns operate as contract carriers in the freight field and on special cruise runs handling passengers. In addition to the common carriers, there were in 1950 about 12,000 vessels of various descriptions used in the fishing industry and for recreational and personal transportation.

Aviation was a pioneer industry in Alaska. Because of the vast distances and rugged terrain separating communities, the aeroplane quickly became the accepted mode of transportation. The first air-mail service began in 1924. By 1950 seven air carriers were certified for operation over 10,064 route miles. In addition, two domestic and one foreign air carrier operated scheduled service over 6,177 route miles within the territory.

Prior to World War II Alaska had no highway system. The principal highway at that time was the Richardson, linking Valdez with Fairbanks. War construction joined the Anchorage road system with the 371-mi. Richardson highway by means of the 194-mi. Glenn highway, connected the Nabesna road with the Alaska International highway, and extended the 42 mi. of the Haines boundary road to connect with the Alaska highway in the Yukon Territory In 1950 Alaska had an interior highway system of 2,871 mi. There were in addition 356 mi. of road in the national forests, the majority leading from southeastern Alaska communities.

Constructed at the turn of the 20th century, the 111-mi. White Pass and Yukon route extending from tidewater at Skagway to Whitehorse in the Yukon Territory was the first railway built in Alaska. Only 20 mi. of this railway, however, lie in the territory. The United States government authorized construction of the Alaska railroad in 1914. The rail lines were completed from the port of Seward to Fairbanks, a distance of 470 mi., in 1923 at a cost of $56,000,000. During the fiscal year ending June 30, 1950, the railroad transported 875,561 revenue tons and 104,300 passengers. Its assets were valued at approximately $83,500,000.

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(E. GRU.)

**ALASTOR,** in early Greek mythology, the spirit of revenge, that prompts the members of a family to commit fresh crimes to obtain satisfaction. Further acts of vengeance transmit the curse from generation to generation. The word is also used for a man's evil genius which drives him to sin; a man so driven is sometimes called *Alastor.* The epithet is applied to the Furies (Erinyes) as the deities of revenge, and to Zeus when he is invoked as the "Avenger."

**ALA-TAU** (variegated mountains) is the name given to the following ranges in Asiatic Russia: (1) Terskei, (2) Kunghei and (3) Trans-ili, all three linking the Tian Shan and the Alexander range. (1) Lies south, and (2) and (3) north of and parallel to Lake Issyk-Kul. Average height 6,000–7,000 ft. (Mt. Talgar 14,990 ft.). Snow-line 11,000–11,700 ft. (4) Also called Talastau, west by south from the Alexander range. (5) Dzungarian Alatau, a range bordering the Dzungarian gate, north of the Tianshan, average height 6,250 ft., max. 11,000 ft. (6) Kuznetsk-Alatau, between the upper Ob and the upper Yenisei, west of the Abakan mountains.

Average height 6,000–7,000 ft.

**ALATYR,** a town in Chuvash, A.S.S.R. Pop. (1935) 22,689. It is situated in latitude 54° 53′ N. and longitude 46° 30′ E., at the junction of the Alatyr and Sura rivers. It has a grain elevator and an extensive grain trade, also flour mills and starch factories.

**ALAUNA, ALAUNUS,** the Celtic names of two rivers, etc., in Roman Britain. Hence the modern Allan Water, river Alyn, etc.

**ALAUSÍ,** a town in the inter-Andine province of Chimborazo, Ecuador, on the Guayaquil-Quito railway and the proposed route of the Pan-American highway. The town is in the plain of Alausí and on the river of the same name. The chief resources of the area are agricultural and pastoral. Population (1942) 11,850.

**ALAVA, DON MIGUEL RICARDO DE** (1770–1843), Spanish general and statesman, was a member of the assembly at Bayonne in 1808 which accepted Joseph Bonaparte as king of Spain, but shortly afterwards joined the national independent party which was fighting in alliance with the English.

He was Spanish commissary at Wellington's headquarters, and became a brigadier-general. In 1815 he was ambassador at The Hague, and was present at the battle of Waterloo. He had served at Trafalgar on the flagship of his uncle, Admiral Alava, and was said to be the only man to have been present at both Trafalgar and Waterloo. He was a deputy to the Cortes in 1820, and in 1822 fought in the militia to support the Cortes against the rebels. Alava took part in the negotiations for the restoration of Ferdinand, but was soon driven into exile. Returning to Spain after Ferdinand's death, he supported Maria Christina against Don Carlos, and was ambassador, first to London (1834) and then to Paris (1835).

He refused to take the oath to the Constitution of 1837, and died in exile at Barèges, France, in 1843.

**ÁLAVA,** one of the Basque Provinces of northern Spain. Pop. (1940) 112,876, area, 1,176 sq.mi.; density per sq.mi., 96.0. The countship of Treviño (190 sq.mi.) in S. Álava belongs to the province of Burgos. Álava (Basque *araiiar,* country set among mountains) is in the west and north-west of a district of mountain and valley, drained by the rivers Bayas and Nervión. The centre of the province is the large, fertile plain of Vitoria which continues to the west the structural trough separating the Sierra de Aralar, on the north, from the Sierra de Andia, on the south. The

Montes de Vitoria separate this plain from the lower plain of Treviño, a dried-up lake basin running east from the Ebro at Miranda and bounded on the south by the Sierras de Toloño and de Cantabria. South of these sierras lies the lowest of the three plains of the province, the Alavese Rioja, with a water-frontage on the Ebro between Haro and Logroño.

Formerly a lordship, governed by an elective *señor,* Álava was incorporated in Castile in 1332 at the request of the electoral corporation of clergy and nobility, who celebrated with Alfonso XI. of Castile the Convention of Arriaga defining administrative relations between the lordship and Castile. The modern province is in many respects transitional between the Basque country and Castile. Castilian is the ordinary language except in the north.

Rainfall is fairly regular, except in the Alavese Rioja. About a quarter of the soil of the province is cultivated, producing wheat, barley, oats and sugar beet; maize is grown on the Biscayan and Guipuzcoan border only. Agricultural methods are, for Spain, progressive, owing to the educative effect of sugar-beet cultivation, and artificial fertilizers and modern ploughs are in general use. The wine of the province is renowned, especially that of the Alavese Rioja; attacks of phylloxera have diminished the area devoted to viticulture, but many acres were replanted with American stocks. Forests of chestnut, oak and beech, controlled by the provincial authority, and rough pastures occupy almost half of the province.

Livestock includes horned cattle, sheep, goats and swine. Goats and sheep are exported to Barcelona, cattle to the market of Bilbao. Irrigation is not in use except for horticulture, but the streams are harnessed to supply electric power and light. Salt, lignite and asphalt are worked. Steel, pig-iron and puddled iron are produced, and there are manufactures of beds, furniture, railway carriages, matches, paper, sweets and woollen and cotton goods. Bread-stuffs, colonial products and machinery are largely imported. In Álava the rate of illiteracy is only 16.24%; there are secondary schools at Vitoria, the capital (pop. 1940, 44,341), which is the only town of more than 3,500 inhabitants, and good normal schools for teachers of both sexes.

The province was the scene of heavy fighting in the civil war of 1936–39 before it finally fell to the nationalist armies of Gen. Francisco Franco. (*See* BASQUE PROVINCES.)

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**ALB,** a liturgical vestment of the Catholic Church. It is a sack-like tunic of white linen (Lat. *alba,* white) with narrow sleeves, and a hole for the head to pass through, and when secured round the waist by the girdle (*cingulum*) just clears the ground. Albs were originally plain, but about the 10th century the custom arose of ornamenting the borders and the cuffs of the sleeves with strips of embroidery, and this became common in the 12th century. These at first encircled the whole border; but soon it became customary to substitute for them square patches of embroidery or precious fabrics. These "parures," "apparels" or "orphreys" (Lat. *parurae, grammata, aurifrisia,* etc.) were usually four in number, one being sewn on the back and another on the front of the vestment just above the lower hem, and one on each cuff. A fifth was occasionally added just below the neck opening. In the 16th century the parures began to go out of use, and broad bands of lace soon afterwards replaced them, as in a magnificent specimen preserved at South Kensington. Apparelled albs are now only in regular use at Milan (Ambrosian Rite), and, partially in certain churches in Spain; but attempts have been made, especially in England, to revive their use.

The alb is worn by bishops, priests, deacons and subdeacons under the other eucharistic vestments at mass and at functions connected with it. It is sometimes also worn by clerics in minor orders, whose proper vestment is, however, the surplice—itself a modification of the alb. (*See* SURPLICE.) The alb is supposed to symbolize purity, and the priest, when putting it on, prays: "Make me white, O Lord," etc. In the middle ages the parures were taken to symbolize the wounds of Christ; and at Toledo the singers of the Passion on Good Friday still wear apparelled albs.

In England at the Reformation the alb went out of use with the other "Mass vestments," but was reintroduced in the ritual revival of the 19th century. It is now worn in many churches not only by the clergy but by acolytes and servers at the Communion. Where the ritual is a revival of pre-Reformation uses, these albs are frequently apparelled. (For the question of its legality *see* VESTMENTS.)

Both the alb and its name are derived from the *tunica alba,* the white tunic, which formed part of the ordinary dress of Roman citizens under the empire. The date of its definite adoption as a liturgical vestment is uncertain; at Rome—where until the 13th century it was known as the *linea* or *camisia* (*cf.* the modern Italian *camice* for alb)—it seems to have been thus used as early as the 5th century. But as late as the 9th and 10th centuries the *alba* is still an everyday as well as a liturgical garment, and we find bishops and synods forbidding priests to sing mass in the *alba* worn by them in ordinary life. (*See* Braun, p. 62.) In mediaeval inventories are sometimes found *albae,* described as red, blue or black; it is clear, however, from the descriptions of these vestments that in some cases they were actually tunicles, the confusion of terms arising from the similarity of shape (*see* DALMATIC); in other cases the colour applied to the parures, not to the albs as a whole. Silk albs appear in the inventories, but only very exceptionally.

The equivalent of the alb in the Eastern Churches is the sticharion (*στιχάριον*) of the Orthodox Church (Armenian, *shapik;* Syrian, *Kutina,* Coptic, *stoicharion* or *tuniah*). It is worn girdled by bishops and priests in all rites, by subdeacons in the Greek and Coptic rites; ungirdled, by deacons and lectors in all the rites. It is usually white for bishops and priests; for the other orders all colours, except black, may be used. Its material may be linen, wool, cotton or silk; but silk only is the rule for deacons. In the Armenian and Coptic rites the vestment is often elaborately embroidered; in the other rites the only ornament is a cross high at the back, save for bishops of the Orthodox Church, whose sticharia have two vertical red stripes (*πόταμοι,* "rivers"). As in the West, the vestment is specially associated with the Eucharist. The whole subject is exhaustively treated by Father Joseph Braun in *Die liturgische Gewandung* (Freiburg im Breisgau, 1907). (*See* also bibliography to the article VESTMENTS.)

**ALBA,** town and episcopal see, province of Cuneo, Piedmont, Italy, 42 mi. S.E. of Turin by rail. Pop. (1936) 11,072 (town), 17,308 (commune). The fine cathedral, with Gothic façade, was rebuilt in 1486. *Alba Pompeia* was probably founded by Pompeius Strabo (consul 89 B.C.) when he constructed the road from Aquae Statiellae (Acqui) to Augusta Taurinorum (Turin). The emperor Pertinax was born here. It became an episcopal see dependent on Milan in the 4th century. It is the centre of a wine-growing district.

**ALBACETE,** inland province, southeast Spain, formed in 1833 out of the northern half of Murcia. Pop. (1940), 374,472, area, 5,739 sq.mi.; density per sq.mi. 65.3. A somewhat featureless province except for the Sierra de Alcaraz in the west, Albacete continues southeast of the monotonous arid steppe land of La Mancha. Lying in the southeastern corner of the central plateau, where the border of the plateau is less clearly marked by mountains than elsewhere, the province is crossed by the main routes from Madrid both to the Valencian plain and to the southeast. The drainage is almost entirely to the Mediterranean by the rivers Júcar and Segura, but the rainfall is low and the province contributes little to the volume of these rivers except from the western sierras. In these sierras the snow lies for several months; elsewhere the climate is mild and healthy. About 55% of the province is cultivated land, of which cereals—wheat, barley, oats, rye and maize in order of importance occupy nearly half. Albacete is a stock-raising province, but the acreage devoted to wheat shows a steady rise, with much breaking-up of natural pastures and a corresponding decline in livestock. Of these, sheep, belonging to the large Manchigan breed with its all-round production, are the most important; sheep and wool are exported to Barcelona and Valencia, and cheeses to all parts of Spain.

The vine has suffered much from the repeated attacks of phyl-

loxera, and replacement with local stocks has been unsuccessful; olives are cultivated; the peaches of the Cabriel and Júcar valleys supply canning factories in Valencia. Saffron and esparto (wild) are exported, and employ much labour. There are important pine forests. Manufactures are almost confined to the spinning of hemp and the making of coarse cloth, porcelain, earthenware and cutlery. Brandy is distilled, and there is some trade in wood. Albacete, the capital (pop. 1940, 50,567), and the other important towns, Almansa and Hellin, are described separately. The railroad from Madrid to Albacete passes southwest to Chinchilla, where it bifurcates, one line going to Murcia and the other to Alicante. A large part of the province is accessible only by road. In respect of elementary education, Albacete is one of the most backward provinces. Albacete remained in loyalist hands until the end of the civil war of 1936–39.

**ALBACETE,** capital of a Spanish province, is in a fertile plain where the Balazote unites with the canal of María Cristina, which flows into the Júcar, 16 mi. to the north. Pop. (1940) 50,567 (mun., 64,222). Albacete comprises the picturesque old upper and lower town mostly erected after the city became a provincial capital in 1833. Chiefly a market-town for saffron and other agricultural produce and for live-stock, it also manufactures matches. Albacete formerly had an extensive trade in cutlery, from which it was named the Sheffield of Spain, and its daggers are still held in high repute by Spaniards.

**ALBACORE,** a large West Indian fish allied to the tunny (*q.v.*). The name is also applied to an allied species in the Pacific.

**ALBA FUCENS** (mod. *Albe*), an ancient Italian town on a lofty site (3,347ft.) at the foot of Monte Velino, 4m. N. of Avezzano. Originally a town of the Aequi, on the frontier of the Marsi, it was occupied by a Roman colony and its fortifications (*c.* 300 B.C.) persist. It lay on a hill just to the north of the Via Valeria, which was probably prolonged beyond Tibur at this very period. Later it became a regular place of detention for important State prisoners, such as Syphax of Numidia, Perseus of Macedonia, Bituitus, king of the Arverni. Its strong position made it important in the civil wars. The external walls, a circuit of about 2m., are of polygonal masonry; carefully jointed, with faces smoothed. The gates as a rule come at the end of a long, straight stretch of wall, and are placed so as to expose the right side of an attacking force. On the north there is, for a length of about 150yds., a triple line of defenses of later date, possibly added by the Roman colonists, inasmuch as both the city wall proper and the double wall thrown out in front of it are partly constructed of concrete and faced with finer polygonal masonry.

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**ALBA IULIA,** a town of Transylvania, Rumania (Ger. *Karlsburg,* Hung. *Gyula-Fehérvár*), situated on the Mureș, 73m. S. of Cluj by rail. Pop. (1930) 12,457. Alba Iulia, which consists of an upper town or citadel, and a lower town, is the seat of a Roman Catholic bishop and has a fine cathedral in 11th century Romanesque, rebuilt in 1443 by John Hunyady in Gothic style. It contains among other tombs that of John Hunyady. Near the cathedral are the episcopal palace and the Batthyaneum, founded by Bishop Count Batthyány in 1794, containing a valuable library with many incunabula and old manuscripts, amongst which is one of the *Nibelungenlied,* an observatory, a collection of antiquities and of minerals. The citadel was built in 1716–35 by the emperor Charles VI. Alba Iulia occupies the site of the Roman colony *Apulum,* and many Roman relics are in the museum. The bishopric was founded in the 11th century by King Ladislaus I. (1078–95). In the 16th century the town became the residence of the independent Transylvanian princes. From this period dates the castle and also the buildings of the university, founded by Gabriel Bethlen and now used as barracks. Alba Iulia with Cluj was the traditional centre of the Rumanian national movement in Transylvania; it was here that Michael the Brave proclaimed himself prince of Transylvania, Walachia and Moldavia; here the union of Transylvania with Rumania was proclaimed in 1918 and King Ferdinand of Rumania was crowned in 1922. Alba Iulia was not in the territory ceded by Rumania to Hungary at the award of Vienna Aug. 30, 1940, during World War II.

**AL-BALADHURI** (Aḥmad ibn Yaḥya) (d. 892), native of Baghdad; one of the earliest Arab historians and the best authority for the period of the formation of the Arab empire. His chief work, *Futûh al-Buldân,* gives an account of the conquest of Arabia, Syria, Mesopotamia, Armenia, Egypt and north Africa, Spain, the Mediterranean islands, Nubia, Persia, and Media. It has been translated into English by P. K. Hitti under the title *The Origins of the Islamic State* in the *Studies in History, Economics and Public Law* series of Columbia university (1916). A second work, *Ansâb al-Ashrâf* (Lineage of Nobles), was edited by Flügel (Leipzig 1835).

**ALBA LONGA,** an ancient city in Latium, on the western edge of the Albanus Lacus, about 12m. S.E. of Rome. Ascanius is the traditional founder and said to be the oldest of Latin cities, destroyed by its daughter city of Rome, under Tullus Hostilius, to which passed the hegemony of the Latin league. It has by many topographers been placed between the Albanus Mons and the Albanus Lacus, according to the indications of Dionysius, at the monastery of Palazzolo; but the position is quite unsuitable and does not answer to Livy's description, *ab situ porrectae in dorso urbis Alba longa apellata* (it was called Alba[1] Longa because it stretched along a narrow ridge); and its site is probably on the west side of the lake, where the modern Castel Gandolfo stands. Confirmation of this may be found in Cicero's description (*Pro Milone,* 85) of the destruction of the shrines and sacred groves of Alba by the construction of Clodius's villa, in the local application of the adjective *Albanus,* and in the position of Castel Gandolfo itself. Only the necropolis remains are preserved; the earliest tombs are Villanovan (about 1100 B.C.). Later ones are 7th and 6th centuries B.C. None was found, as has been alleged, buried by a subsequent eruption of the Alban volcano. The name *Albanum,* from about 150 B.C. till the time of Constantine, meant a villa in the Alban territory. The emperors formed a single estate out of a considerable part of this district, including apparently the whole of the lake, and Domitian was especially fond of it. The imperial villa occupied the site of the present Villa Barberini at Castel Gandolfo, and considerable remains still exist. To the south a camp, with baths, an amphitheatre, a large water reservoir, etc., was constructed for the Second Parthian legion, as his bodyguard, by Septimius Severus. The camp was given up in the time of Constantine, when the *Civitas Albanensis* arose.

The lapis Albanus is a green grey volcanic stone with black and white grains in it (hence the modern name, peperino), much used for building material in Rome and its neighbourhood.

For detailed accounts *see* T. Ashby, *Jour. Phil.* xxvii. 37 (1901); G. Lugli, *Ball. Comm.* (1917–20) and *Ausonia,* ix. 211; x. 210. MacIver, *Villanovans and Early Etruscans* (Oxford, 1924); *Italy in the Iron Age* (Oxford, 1927).

**ALBAN, SAINT,** the first martyr of Britain, is said to have been born at Verulamium (St. Albans, Hertfordshire) and to have served for seven years in Rome in the army. On his return to Britain he is said by Gildas to have been put to death as a Christian during the persecution of Diocletian (*c.* 286–303), according to Bede, at St. Albans. As there is no certainty that the persecution of Diocletian extended to Britain it is possible that his martyrdom should be ascribed to that under Decius (250–251) or that of Valerian (259–260). A church was built on the place of his martyrdom, *c.* 793. A monastery was subsequently added, and around it the present town of St. Albans gradually grew up. Pope Adrian IV., who was born in the neighbourhood, conferred on the abbot of St. Alban's precedence over his fellow abbots, a right hitherto attached to the abbey of Glastonbury. St. Alban is commemorated in Catholic martyrology on June 22 and in the Church of England on June 17.

*See* U. Chevalier, *Répertoire des sources historiques* (1905), i. 95; D. Hardy, *Descriptive Catalogue* (1862), I. i. 3–34, ii. 688.

**ALBANI, DAME EMMA,** *née* LAJEUNESSE (1852–1930), celebrated Canadian singer, who was born in Chambly, Quebec,

[1]Whether Alba means "white" is very doubtful: it is more probably derived from the root Alp.

on Nov. 1, 1852. She made her first public appearance in Montreal, at the age of seven, and after studying at Milan with Lamperti (having meanwhile adopted for stage purposes the name of Albani, after that of an extinct Italian family) she made her début at Messina in Bellini's *La Sonnambula,* achieving an immediate success, which was repeated when two years later, on April 2, 1872, she made her first appearance at Covent Garden in the same opera. Thenceforward for a long period she enjoyed the widest fame and popularity, being not less esteemed as a woman than admired for her art. She married in 1878 Ernest Gye, who died in 1925, and in the same year she was accorded the D.B.E. She died in London on April 3, 1930.

*See* her *Forty Years of Song* (1911).

**ALBANI** or **ALBANO, FRANCESCO** (1578–1660), Italian painter, was born at Bologna. His first master was Denis Calvert, with whom Guido Reni was at the same time a pupil. He was soon left by Calvert entirely to the care of Guido whom he followed to the school of the Caracci. Albani opened an academy in Rome, where he resided for many years. Here he painted, after the designs of Annibal Caracci, the whole of the frescoes in the chapel of San Diego in the church of San Giacomo degli Spagnuoli. His best frescoes are those on mythological subjects, of which there is a larger number in the Verospi, now Torlonia palace. A number of his works are at Bologna, and others at Florence, the Louvre, Dresden and Leningrad.

**ALBANIA,** called in its indigenous language Shqipenija or Shqiperia ("Eagles' country"), is a state situated on the western coast of the Balkan peninsula, comprising the former Turkish province of Scutari with parts of the province of Janina and of the vilayets of Kosovo and Monastir and having an area of 10,629 sq.mi. and a population estimated at 1,200,000 in 1951. It is bounded on the west by the Adriatic sea, on the north and on the east by Yugoslavia, on the southeast by Greece and on the southwest by the Ionian sea. It became a People's republic after World War II.

**The Country.**—The Albanian lands lie athwart the mountain chain of the Dinaric Alps, but there, as contrasted with Dalmatia to the north and Greece to the south, these stand back from the sea, from which they are separated by a marshy and malarial lowland, crossed by several important rivers. The actual coast is generally low, and the shore waters are rendered turbid by the silt carried down by the rivers, thus contrasting markedly with the clear blue tint off the limestone country further north. Equally marked is the general absence of the coastal settlements so characteristic of most parts of the Mediterranean. Southward, in the region near the port of Valona, the coastal lowland disappears, and limestone hills again approach the water's edge. In this, the region anciently called Epirus, the Greek mode of life becomes visible, though Greek penetration was always limited. The Albanians have been and still are mainly mountain folk, occupying the hilly interior rather than the coastal lowland. The continuity of the mountain belt gives them a certain cultural unity, while at the same time the fact that it is broken up into a series of small natural regions, more or less isolated from each other, made the growth of a national spirit a slow process. The country has thus three essential features which go far to explain the history and characteristics of its people: because of the littoral plains it marks a definite break in the otherwise mountainous west coast of the peninsula; its elevated hinterland forms a natural refuge between the seaway to the west and the north-to-south land routes of the interior of the peninsula; within the mountain belt lie valleys and basins of considerable productivity, capable of supporting fairly dense populations. The aloofness both of the land as a whole and of its centres of settlement led to Albania's being one of the least known parts of Europe, and within the country the primitive and the modern jostle one another. Thus there are regularly scheduled air routes, wireless stations and a considerable number of roads suitable for motor traffic; but at the same time the simple wooden plow, which scarcely does more than scratch the ground, is of archaic type. The language of the country is practically unknown beyond its own borders.

**Structure and Relief.**—If Albania be first conceived as consisting of a marginal lowland, crossed by powerful perennial streams, and a complex mountainous hinterland enclosing small fertile basins, the details of the picture may be filled in as follows. To the north the Albanian Alps, built largely of massive limestones, form the outstanding feature. They have a general west-to-east direction, roughly parallel to the course of the lower Drin, below the junction of the two streams of the Black and White Drin. The Black Drin is the effluent of Lake Ochrida (Ohrid), and flows northward, draining a large part of eastern Albania, while the White Drin enters the country from Yugoslavia, flowing in a southerly direction. Below the confluence the river swings round at a sharp angle to cut through wild mountainous country, in a series of inaccessible gorges, on its way to the Adriatic. It receives a number of swift tributaries from the Albanian Alps, these also flowing in deep, steep-sided gorges, for the southern slopes of the mountains are remarkably abrupt and rocky. The result is that the actual valley of the lower Drin is not, as one might suppose, a line of access to the interior, the only practicable route from the coast to the confluence of the two headstreams running well south of the river in the hilly Mirdita region. No bridge crosses the Drin in its gorge section, and as it is too deep to be forded, the inhabitants usually cross it by swimming, supported by inflated skins.

The Albanian Alps rise to heights of 6,500–8,500 ft. above sea level, and to the northwest, where limestones predominate, they are practically a continuation of the high karst of Montenegro. To the northeast, however, other rocks, particularly Palaeozoic schists, appear and the scenery is of a different type. The steep lower slopes are thickly wooded, for the region has one of the highest mean annual rainfalls in Europe. At the higher levels, however, where considerable plateau tracts occur, there are wide summer pastures. Though in the strict sense there is no permanent snow, patches linger throughout the summer, and a very slight change in the climate would give the chain a snowcap. It was heavily glaciated during the Ice Age, and the effects of ice erosion have been to accentuate its inaccessibility and high relief. Except on their margins the mountains are virtually devoid of permanent habitations, and thus at first sight they would appear to form an admirable boundary zone. But, as has been noted by travellers, parts of the higher levels swarm with herdsmen and their flocks during the summer season, and these mountain pastures are an economic necessity to the inhabitants of the lower grounds. Great difficulties have consequently arisen in demarcating frontiers, for the line of the water parting, so often chosen as a basis, may separate a group from its pastures and thus inflict great hardship. In limestone regions, also, the water parting may be very difficult to trace.

Westward the Albanian Alps cease abruptly about 30 mi. from the Adriatic coast, giving place to quite a different type of country. Though much of it lies below 600 ft., it is not a uniform plain, and there is a belt of hills between Lake Scutari (Shkodër) and the sea. The structure is, however, perfectly clear and simple. Low limestone hills indicate that the coastal chains of Dalmatia are continued there, but two separate facts introduce a new note. The first is that depression has taken place on a much greater scale than farther north, and the second is that extensive silting has occurred, so that the sunken hill-ridges are largely submerged beneath a mantle of recent deposits. Lake Scutari itself represents an area of depression in which the filling has been incomplete. The Drin, on emerging from its gorge, swollen by the water from the Albanian Alps, has great difficulty in finding its way through the maze of its own deposits and those of its tributary the Kiri. Up to 1858 it turned southward past Alessio (Lesh) and discharged its waters by a swampy, wooded delta just south of the port called by the Italians San Giovanni de Medua and by the Albanians Shën Gjini. In 1858, during a period of high flood, it broke through to the Bojana (Buenë), the effluent of Lake Scutari, and most of its water now follows this course, the older one carrying but a small part. This caused a rise in the level of Lake Scutari, with a flooding of parts of its margins,

and also obstructed the channel of the Bojana, formerly navigable, by the silt thus poured into it. As in all such changes of river course, deserted channels and pools were left to become breeding places of mosquitoes and thus form foci of malaria.

South of this frontier zone of coastal lowland and inland mountain belt the conditions are much more complicated, both in regard to geological structure and relief. The mere fact that the Drin, after a lengthy course as the Black Drin in the interior, should cut its way through the mountains in a gorge more than 3,000 ft. deep and more than 30 mi. long is enough to suggest that there have been earth movements on a considerable scale. As far as geographical effects are concerned, however, the matter may be simply put. The course of the lower Drin marks a change in the direction of the mountain folds, associated with changes in their characters. The outer or coastal folds have sunk, and at the same time rocks from the west have been thrust over them. The inner folds have been elevated, and as a result their surface rocks, including Tertiary sandstones and Cretaceous limestones, have been for the most part worn off, exposing the deeper beds, mainly serpentines, below. These serpentines give rise to rounded land-forms, far less repellent than massive limestones, even though the elevation is considerable, a number of crests rising more than 6,500 ft. with a maximum of nearly 9,000 ft. The region has also been cut up by river action so that it is by no means uniformly high, but encloses small plains whose floors in some cases sink to only about 650 ft. above sea level.

South of the Semeni river the low ridges rise to greater heights and the limestones reappear beneath the sandstones. Still further south, beyond the Viosa river, the elevation increases to more than 6,000 ft., the limestones are fully developed, the sandstone covering disappears from the crests, though it remains in the intervening furrows, and the lowland gives place to the mountainous Epirus region, continued beyond the frontier into Greece. The vegetation undergoes a corresponding change, woods tend to disappear, and the summits are clothed with scanty herbage, again forming summer pasturages. This type of country is continued southward into Greece, and frontier lines are difficult to draw, for the whole tract is the natural home of wandering shepherds. No notable difference of elevation separates this littoral Epirus area from the mountain zone of interior Albania, but it is still possible to distinguish between the two because of the great simplicity of structure of the western folds.

From the western shores of Lake Ochrida toward the lower Drin there extends northward a mountain belt consisting of a series of blocks separated by mountain passes. This forms a central backbone repelling settlement to its margins. It is highest to the south, where also it forms a single chain, and becomes lower toward the north, where it tends to consist of rows of hills rather than of a single ridge. Finally it merges into the complex hilly country of the Mirdita, south of the lower Drin, where settlement becomes possible on the flanks of the hills as well as in the intervening valleys. Except in the extreme south, most of this central hill belt is heavily wooded, especially with beech. Above the tree limit occur the usual high pastures.

At either side of this chain lie long furrows, each consisting of a succession of basins and gorges and forming one of the most characteristic features of the country. The eastern furrow is traversed by the Black Drin and is bounded by another mountain belt on its eastern side. It might be supposed, therefore, that this mountain belt would form the eastern frontier of Albania with Yugoslavia. But this is only the case to a limited extent, for south of Dibra (Debar), on the Black Drin, the Yugoslav frontier is pushed westward and includes that town, a part of the river and the greater part of Lake Ochrida. This is but another illustration of the difficulty of drawing satisfactory frontiers in the Balkan peninsula. The difficulty here depends on the peculiar topography which is itself a result of recent earth movements. It is a characteristic feature of Macedonia that large depressed basins occur which, even when they are strung along the same river system, are separated physically from one another by mountain sills, cut through by the river in gorges. Because of these sills it happens frequently that basins belonging to separate river systems are in closer touch with one another than those linked by a single river. The Black Drin shows very markedly this feature of successive basins and gorges, the basins being largest to the south and smaller toward the north. The largest is that which is mainly submerged beneath the waters of Lake Ochrida. It is a general rule in Albania that, as compared with Macedonia, the basins are small and thus only moderately productive and not capable of supporting a dense population. At the same time the intervening gorges tend to be longer and more forbidding, and the possibility of linking effectively successive series of basins by transverse routes is much less notable. These differences have had a cumulative effect on the inhabitants of the two areas, and the present frontier, which assigns the greater part of the larger southern basins to Yugoslavia (the power which holds the adjacent section of Macedonia there) and the smaller, more northerly ones to Albania, is drawn mainly on an ethnic basis, racial distribution there being a reflection of the topography.

Some of the basins on the course of the Black Drin may be noted. The largest, as just stated, is occupied by Lake Ochrida, of which only the southwestern corner falls in Albania. There lies the settlement of Pogradets. Still further south there lies a large basin containing the town of Koritsa (Korçë), but this is best considered with the western furrow rather than with that of the Black Drin. On emerging from the lake that river passes through a heavily wooded gorge to emerge at the basin of Dibra. Though most of this basin lies in Yugoslavia, its Albanian side is also capable of settlement. A low ridge separates this basin from that of Peshkopijë (Peshkopi), farther north, and the alternation of basin and sill is continued to and even beyond the confluence of the Black and White Drin. In each basin there tends to be a market centre, but the point of importance is that the floor of the whole basin is capable of yielding cereals, especially maize and wheat, so that each forms a centre of settlement more or less isolated from its neighbours and necessarily self-sufficing.

To the west of the central mountain belt lies the second furrow, differing in several respects from that of the Drin. Though bounded on the west by the hill belt which forms the inner margin of the coastal lowland, it lacks the continuity given to its easterly counterpart by the Black Drin. A belt of highland forming the water parting between the upper Mati and a right-bank tributary of the Shkumbi divides it into a northern and a southern section, drained respectively by the upper Mati and the upper Shkumbi. North and south of this wooded and impassable highland passes permit communication with the Black Drin furrow, downstream from Dibra on the one hand and in the Lake Ochrida area on the other. The latter line is particularly important as it was followed by the Roman Via Egnatia, which passed from Durazzo (Durrës) to Elbasan (placed where the Shkumbi emerges from the hill country) and then by way of the basin traversed by that river to the shores of Lake Ochrida, which was rounded to the north. The existence of this route shows that the Shkumbi furrow is much less isolated than parts of the Drin furrow.

The headstream of the Shkumbi approaches very closely the valley of the Devoli, one of the two feeders of the Semeni river. The Devoli drains the basin of Koritsa, to the south of Lake Ochrida, and may be said to mark the region of convergence of the two furrows, the eastern and the western. Koritsa is a fairly important route centre, being connected southward through Albanian Epirus with Janina in Greek Epirus, eastward with Kastoria in Greek Macedonia, and westward by the Devoli valley with the coastal lowland as with Durazzo via Elbasan and with Valona (Vlonë). To the southwest of the Koritsa basin lies the smaller one of Kolonja, traversed by the Liumi Beratit (Usum), the other feeder of the Semeni.

**Climate and Natural Vegetation.**—The coastal lowland, together with the littoral part of the Epirus region, has the typical Mediterranean climate, with summer drought accentuated by high summer temperatures. But this type has a limited distribution. Even in the Epirus region the elevation brings changes, diminishing the heat of summer and slightly increasing its rainfall. The southern part of inner Albania, at least in the basins, shows the modified Mediterranean or Macedonian type. The summers are

hot, apparently even hotter than in the lowland, but winter frosts occur.

The natural vegetation reflects these climatic conditions. Near the coast the characteristic Mediterranean scrub or *maquis* occurs, though this has been largely cleared. It had always a somewhat limited distribution, and the most widely distributed plant association in the south is oak wood, or rather oak scrub-forest. The oaks are of the evergreen, drought-resisting type and are not only valuable as sources of fuel but also important in the low grounds as furnishing in their leaves and shoots supplementary winter fodder. Even cattle and horses eat oak leaves in Albania. To the north, with the heavier rainfall, the oak woods give place to luxuriant mixed forest, with beech as a predominant element, mingled with pines and firs. (M. I. N.; X.)

**History.**—After the division of the Roman empire, northern and southern Albania became the Byzantine provinces of Dyrrachium and Nicopolis. Overrun by the Goths in the 4th and 5th centuries, they were reconquered by Justinian in 535. In 640 northern Albania was invaded by the Serbs. The Bulgarians conquered southern Albania in 861, defeated the Serbs (893–927) and established themselves (976–1014) in the greater part of the Balkan peninsula; but in 1014 the emperor Basil II reconquered southern Albania, which remained under Byzantine rule until 1204, when Michael Comnenus, of the imperial family, founded the independent despotate of Epirus, which included southern Albania, Acarnania and Aetolia. In 1318 the despotate passed to the princes of the house of Orsini, who ruled it until 1358. Meanwhile the Sicilian kings acquired and held central Albania (1271–1368). In 1180 the Serbs had reinstalled themselves in the provinces of Scutari and Prizren, and Stephen Dushan (1331–58) included all Albania in his ephemeral empire. Large numbers of Albanians under Jin Bua Spata and Peter Liosha emigrated southward before Dushan's hordes, took Janina and Arta and penetrated as far as Acarnania and Aetolia (1358), while colonies were established in the Morea, Attica and Boeotia.

After the death of Dushan, Albania fell under the rule of native chieftains; but a Norman knight named Balsha, who had served under Dushan, established a dynasty at Scutari (1366) and induced the chieftains to co-operate under his leadership against the Serbs and Bulgarians. The power of the Balshas was, however, short-lived. At the close of the 14th century the Venetians established themselves at Durazzo, Scutari and Antivari, and in 1421 the dynasty came to an end.

**Turkish Rule.**—The advance of the Turks, who captured Janina in 1431, reunited the Albanian chieftains (1444–66) under the immortal George Kastriota of Kroia (*see* SKANDERBEG) and thereafter under the Venetians. But Kroia surrendered in 1478, Scutari in 1479, Durazzo in 1502 and Antivari and Dulcigno, the last Venetian possessions in Albania, in 1571. Many Albanians fled with their Venetian allies to Dalmatia and Italy. Although more than half the Albanian race abandoned Christianity—in the lowlands that it might enjoy equality with the Turks and in the northeastern highlands that it might obtain their support against its hereditary foes, the Slavs—Ottoman sovereignty was never effectively established, and against it the Albanians intermittently revolted. In about 1760 Mehmed Bushati, pasha of Scutari, rallied the northern clansmen and threw off Turkish suzerainty. His son, Mahmud the Black, routed three Turkish armies, but with the defeat of his grandson Mustafa in 1831 the power of the Bushati was broken. Meanwhile, in southern Albania, the able Ali Pasha of Tepelen (*see* ALI, known as ALI PASHA), by a combination of cunning and brutality, established a virtually independent state with Janina as its capital and maintained direct relations with foreign powers, but was overthrown by a Turkish army in 1822.

The revival of nationalism in Greece, Bulgaria and Serbia, coupled with the decline of the Turkish empire, induced the Albanians to seek autonomy within the empire while availing themselves of its protection until they were prepared for independence. In 1879 the Porte sought to turn Albanian nationalism to its advantage by encouraging the formation of the Albanian league, which opposed with some success the cession of Albanian territory, as provided for by the treaty of Berlin, to Montenegro and Greece. Once the league had fulfilled its purpose the Porte suppressed it, although not without much bloodshed. Then in 1908 the Albanians threw in their lot with the Young Turks—whose success was due largely to their support—in the hope that in consequence they would obtain autonomy, but the new regime proved worse than the old, and the Albanians rose in revolt against ottomanization. Throughout 1910–11 they struggled unsuccessfully, but in 1912 a general rising was successful: the vilayet of Kosovo was liberated, Monastir threatened, and in August the Turks were obliged to grant autonomy to Albania, which was to include the vilayets of Scutari, Kosovo, Janina and Monastir. But the Balkan states had envisaged the partition of Albania between them and hastened to precipitate war with Turkey. The Albanians, who wished neither to be classed as Turks and share their fate nor to facilitate the overthrow of their protectors and were without any central administration to guide them, remained neutral except at Janina and Scutari, which were vital to their national existence. On Nov. 28, 1912, Ismail Kemal Vlora, diplomatically supported by Austria-Hungary and Italy, proclaimed Albanian independence at Valona but Russia and France supported the Balkan allies, and a general European war was perhaps only averted by British arbitration. The solution of the problem was entrusted to the Conference of Ambassadors in London, which acknowledged the principle of Albanian autonomy on Dec. 20, 1912, and declared Albania an independent sovereign state on July 29, 1913. But the new state's boundaries included less than half the Albanian race.

**World War I.**—Prince William of Wied, selected by the powers to rule Albania as *mbret* (king), landed at Durazzo on March 7, 1914; but the machinations and the intrigues of various neighbouring states rendered his position untenable. Unable to extend his authority into the interior, he left Albania on Sept. 3, although he did not abdicate. Meanwhile, to resist the incorporation of southern Albania in the new state, Greece had instigated during February the constitution of a "Provisional Government of Autonomous Epirus" supported by Greeks masquerading as insurgents. The international situation prevented the powers from interfering, and anarchy continued until Greece was authorized officially to reoccupy southern Albania in the autumn. Italian troops occupied Valona in Dec. 1914, and in 1916 the whole of southern Albania, except the Koritsa (Korçë) region, which was occupied from Salonika by the French, who established an autonomous administration. Early in 1915, the Serbs and Montenegrins occupied northern and central Albania after severe fighting, but after their defeat by the Austro-Bulgarian armies these regions were occupied by the latter in 1916. Albania had no central government, although Essad Pasha posed as its president, and local policies were pursued. On June 3, 1917, Gen. Giacinto Ferrero proclaimed the independence of the whole of Albania under Italian protection, repudiating those clauses of the pact of London (1915) which provided for its partition. After the armistice the Italians occupied most of the country, the French remained at Koritsa until June 1920, the Yugoslavs occupied northeastern Albania and an inter-allied administration governed at Scutari until Feb. 1920. In Dec. 1918 a national assembly at Durazzo elected a provisional government and a delegation to the peace conference. But early in 1920 the Albanians, becoming apprehensive of the intentions of the occupying forces, held a congress at Lushnja, appointed a council of regency (representing Roman Catholics, Greek Orthodox, Sunni Moslems and Bektashis), chose Tirana as their capital and elected a more energetic government. The Italians were driven into Valona in June and withdrew from the country in August. The Yugoslavs were now asked to withdraw too but were reluctant to do so. Desultory skirmishing in the northern mountains culminated, in Nov. 1921, in a sudden Yugoslav attack designed to confront Europe with an accomplished fact, but this invasion was stopped by the intervention of the British government which convened a meeting of the council of the League of Nations (of which Albania had become a member on Dec. 17, 1920). On Nov. 9, 1921, the Conference of Ambassadors confirmed the Albanian frontiers of 1913, at the same time proclaiming that its integrity was necessary for the strategic security of Italy; but tension between Albania and its neighbours continued until minor rectifications of the

frontier were completed in 1926.

**Ahmed Zogu, Zog I.**—Ahmed Zogu, who had become minister of the interior in Albania's sixth postwar cabinet in Dec. 1921 and had added much to his reputation by his suppression of a revolt in the following March, became prime minister in Dec. 1922. Some administrative progress was made with the help of foreign advisers, but Albania sorely needed foreign financial help to develop its modest resources. Zogu's cautious policy of reform was too slow for progressive but politically immature elements, too conciliatory for the irredentists, too national for the mountain tribesmen. His resignation in Feb. 1924 did not satisfy his opponents, and widespread revolt during June drove him and his colleagues into Yugoslavia. Mgr. Fan Noli's government, which then took office, accomplished little, and Zogu was able, with Yugoslav assistance, to organize a well-equipped force with which he crossed the frontier in December and expelled Noli.

On Jan. 22, 1925, a national assembly voted the proclamation of a republic, and on Feb. 1, Zogu was elected president, the regency being abolished. By a generous attitude toward political opponents, Zogu consolidated his position, at the same time making it clear that, although grateful for Yugoslav support, he did not intend to become Yugoslavia's vassal. During Sept. 1923 negotiations with Italy for a loan were concluded and a national bank established, an Italian financial group being the principal shareholder. Relations with Greece, strained over the Graeco-Turkish exchange of populations, in which Greece sought to include the Moslem Albanians of Epirus, were improved through the mediation of the League; and a conciliatory policy toward Yugoslavia improved relations with that country, although proposals for the conclusion of a pact of friendship and security were received unfavourably in Belgrade. Zogu, although anxious to consolidate his position by obtaining support from a neighbouring power without sacrificing independence and although doubtful of the competence of the League—which had failed in his predecessor's case—to prevent his overthrow by bands from across the border, hesitated to turn to Italy, which had acquired already a commercial foothold in the country. But an insurrection in northern Albania in Nov. 1926, perhaps externally inspired, forced his hand. By the pact of Tirana, concluded on Nov. 27, Italy and Albania recognized that any disturbance directed against the established situation of Albania was opposed to their reciprocal political interest and, to safeguard it, undertook to give their mutual support and cordial collaboration.

The pact of Tirana, registered with the League of Nations in Feb. 1927, was followed by the conclusion, on Nov. 22, of a treaty of defensive alliance. Then on Sept. 1, 1928, Zogu was proclaimed Zog I (*q.v.*) king of the Albanians, while a constitution provided for a council of ministers (appointed by the king) and an elected chamber of deputies. Complete religious freedom, existing in practice, was reaffirmed.

Under King Zog, Albania made substantial progress in the educational and economic fields: schools and banks were opened, roads built, a broadcasting station established, the administration improved and the gendarmerie reorganized by an unofficial British mission under Col. W. F. Stirling and (afterward) Gen. Sir J. Percy. In the meantime Italy, under cover of its treaties with Albania, sought by all means to extend its control, pouring in advisers and technicians and a large military mission to train the army. Opposition by Albanian patriots led to the withdrawal of the Italian advisers in 1934, but the breach was patched up by a series of agreements in 1936.

**Italian Occupation and World War II.**—Italy had repeatedly proclaimed its respect for Albania's sovereignty and integrity, but the Italian general staff looked upon it as a bridgehead for the invasion of the Balkans. On April 7, 1939, Italian troops made a surprise landing in strength and quickly overcame Albanian resistance. The king fled abroad with his family, and an "Albanian National assembly" offered the crown to King Victor Emmanuel III of Italy, who accepted. The Italians built up their strength in Albania and, on Oct. 28, 1940, began their invasion of Greece. They were driven back by the Greeks, who occupied most of southern Albania, but in April 1941 Greece and Yugoslavia were overrun by the Germans, who in their turn occupied Albania (*see* WORLD WAR II). Then a native guerrilla movement under Communist direction came into being and, with the aid of small British detachments (landed in 1944) drove the axis forces from a large part of the country—simultaneously liquidating its anti-Communist opponents. Col. Gen. Enver Hoxha, commander in chief of the "Albanian Army of National Liberation," became prime minister with the ambitious Lieut. Gen. Koçi Xoxe as his ruthless minister of interior. It followed that Hoxha's "Democratic Front" won 95% of the votes in uncontested elections for a constituent assembly, which proclaimed a republic on Jan. 11, 1946.

**Communism.**—The dictatorship of Hoxha and Xoxe imposed upon Albania all the trappings and tyrannies of a Communist state subservient to the U.S.S.R. An alliance with Communist Yugoslavia was arranged notwithstanding Albanian national claims to the Kosovo region, while Albania's support of the Greek rebels under Gen. Markos Vafiades and the damage of British warships in the mined straits of Corfu further estranged it from the western powers. Albania was largely reliant upon Yugoslavia at this stage, and its continued independence could perhaps be attributed to soviet hopes that it would be admitted to the United Nations and so bring another vote to the Communist bloc. But when the Yugoslav breach with the U.S.S.R. developed in the summer of 1948 Hoxha held Albania firmly to the soviet side: Xoxe, who held other views and had almost succeeded in supplanting Hoxha, was liquidated with his chief supporters in 1949. Thereafter the U.S.S.R. tightened its grip, and though Albania's immediate value to the soviet cause was diminished by the defeat of the Greek rebels it remained a strategically important advanced base in the Mediterranean area and a thorn in the flank of Yugoslavia. Yugoslavia formally denounced its treaty of friendship with Albania in Nov. 1949; on the other hand diplomatic relations between Albania and Italy were re-established, as Albania needed a convenient source of supply to replace those lost to it by its breach with its eastern neighbour, while Italian security was best served by a friendly policy designed to reduce Albanian dependence upon the U.S.S.R. or Yugoslavia. In the meantime opponents of the Communist regime had been active, and Midhat Frasheri at last succeeded (Aug. 1949), in uniting republicans and royalists. Under Frasheri's leadership a National Committee for Free Albania was established and though Frasheri himself died in the United States two months later his movement continued to grow. (J. Sw.)

**The People.**—The inhabitants are mainly Albanians, or Shqipetars as they call themselves, with a certain admixture of Vlachs, especially in the Epirus region. But not all the Albanians live within the confines of the country. A number, estimated in the 1920s at 250,000, live in southern Italy and Sicily, where their forefathers fled from the Turks in the 15th and 16th centuries. About 50,000 are found in the United States, many emigrants leaving Epirus, a region of poverty. As in other parts of the peninsula, emigration is often temporary, the travellers returning when they have amassed a certain amount of money. In addition roughly a million Albanians live in Greek Epirus, Yugoslav Macedonia and the Kosovo Polje area outside the frontier.

The Albanians have retained their original language and, though dialects occur, the differences are said not to be so marked as to make mutual comprehension impossible (*see* ALBANIAN LANGUAGE). They are divided into Ghegs to the north of the Shkumbi line and Tosks to the south, the latter being apparently the more advanced.

About 69% of the population are Moslem, this being an effect of Turkish rule, but Albanians remained always monogamous. About 10%, mostly in the district of Scutari, are Roman Catholics, while 21%, mostly in the districts of Argyrokastro (Gjinokastër), Koritsa and Valona are Greek Orthodox. At the census of 1930 (latest taken by mid-20th century) there were 688,280 Moslems, 210,313 Greek Orthodox, 104,184 Roman Catholics and 347 others.

From the psychological standpoint the Albanians, about whose characteristics much has been written, may be said broadly to show the features common to isolated mountain folk. As is fre-

quently the case with such stocks their virtues are apt to be more highly estimated by strangers than by those with whom they come in daily contact. Theft and cold-blooded murder are not crimes, either in the estimation of the individual or of his fellows, but a breach of the plighted word or a violation of the duties of hospitality cuts a man off from his family group, and adultery is uncommon. The blood-feud or vendetta, almost inevitable in a country of such loose organization, has been in the past a scourge, and there are said to be still, at least among the Ghegs, groups which hold that the death, even the accidental death, of a kinsman can only be wiped off by the murder of the guilty person or one of his relatives. Associated with this is the strength of the *bessa* or pledge, which protects its holder absolutely. All women are protected by the *bessa,* and so also is any man accompanied by a woman. Boys under 16 years of age, ecclesiastics and generally all those incapable of bearing arms are also protected, while certain places or routes, some occupations, such as irrigation works, and certain periods confer similar rights.

**Towns.**—The principal towns, in order of importance, are (pop., 1930 census; 1949 estimates in parentheses): Tirana or Tiranë, the capital, 30,806 (40,000); Scutari or Shkodër, 29,209 (30,000); Koritsa or Korçë, 22,787 (28,000); Elbasan, 13,796 (18,000); Argyrokastro or Gjinokastër, 10,836; Berat, 10,403; Valona or Vlonë, 9,100; Durazzo or Durrës, 8,739.

## SOCIAL AND ECONOMIC CONDITIONS

**Agriculture.**—The Albanians are almost entirely dependent on the land, carrying on a characteristic combination of pastoral and agricultural occupations. Sheep form the major part of the flocks and yield cheese, which forms an important part of the diet and is exported on a considerable scale, as well as wool and skins. Goats are also reared, but the cattle are of poor breeds, yielding little milk. Oxen, with buffaloes in the swampy plains, are the plow animals. Religion excludes the thrifty pig, save among the Christian tribes, and meat of any kind is a luxury. Even the ewe's-milk cheese is too valuable to be used extensively, and the Albanians are mainly vegetarians, depending on maize bread with vegetables and whey. Horses, donkeys and mules are reared for riding and as pack animals. *See* Table I.

TABLE I.—*Livestock*
(In thousands)

| | 1933 | 1936 | 1938 | 1946* |
|---|---|---|---|---|
| Sheep | 1,500.9 | 1,675.4 | 1,573.9 | 1,548.0 |
| Goats | 928.5 | 975.0 | 923.3 | 854.0 |
| Cattle | 394.8 | 407.2 | 391.2 | 345.0 |
| Pigs | 23.5 | 24.4 | 15.3 | 35.0 |
| Horses | 66.8 | 67.8 | 54.4 | 50.0 |
| Asses | 66.6 | 68.5 | 44.6 | 40.0 |

*Estimates.

Only 10.9% of the surface is arable. The chief cereal is maize, though wheat, oats and barley are also grown. The area under crops was said to be 52% larger in 1950 than it had been in 1938. In the lower grounds all the characteristic Mediterranean fruit-trees, including olive, orange, lemon, fig, etc., can be grown, but the Albanian shows little aptitude for the more delicate operations of arboriculture. The vine is grown on a fairly large scale, especially in the south of interior Albania, and wine is made, but of a quality only fit for local use. Brandy is distilled from a variety of fruits, including mulberries, and alcoholism is said to be one of the curses of the country. Despite the presence of the mulberry, silkworm-rearing is only carried on on a small scale.

TABLE II.—*Agricultural Production*
(In thousand metric tons)

| | 1930–34 | 1935–39 | 1947* |
|---|---|---|---|
| Maize | 96.0 | 128.7 | 140.0 |
| Wheat | 43.3 | 41.0 | 54.0 |
| Oats | 11.0 | 10.3 | .... |
| Barley | 6.6 | 4.7 | .... |

*Estimates.

Rice is produced in the swampy parts of the lowland, and tobacco is fairly widespread and forms an article of export. *See* Table II.

**Mining and Industry.**—The mineral wealth of Albania, thought to be considerable, is not exactly known, no geological survey having been made. Crude petroleum production was developed by the Italians after 1934, wells being tapped at Kuçovë near Berat, at Pëkishtë southwest of Elbasan and at Selenicë and Patos, about 12 mi. N.E. of Valona. Pipe lines carried the oil to Valona and from there Italian tankers transported it to Italian refineries. Production amounted to 2,000 metric tons in 1934 and to 125,000 tons in 1939 and was believed to have reached 200,000 tons in 1942. In 1950 it was estimated at 150,000 tons; by this time Russian tankers were carrying it to Rumanian or Caucasian refineries.

There is also lignite, asphalt and bitumen on the coastal lowlands and certain interior basins. Lignite was extracted in small quantities in the region of Tirana, Tepeleni and Koritsa (4,400 metric tons in 1938). Asphalt and bitumen were worked at Selenicë, products being exported before World War II to Italy (about 10,000 tons in 1938) and from 1948 to the Soviet Union.

Of metallic minerals, pyrites, chromite, bauxite and copper ore were located: pyrites, apparently in large quantities, in the Mirdita region south of the lower Drin gorge; chromite on the western shore of Lake Ochrida and copper in the Pukë region.

Before World War II there were very few industries in Albania: a cement factory at Scutari, a brewery at Koritsa, a few small brick and tile works, several flour mills and some tobacco factories completed the list. Since World War II industrialization made considerable progress. A Lenin dam and power station were completed near Tirana in 1950, increasing tenfold the electricity supply and fourfold the water supply of the capital. In 1951 a Stalin textile works started production at Fieri: it was said that its yearly production of 20,000,000 m. of cotton fabric would satisfy all the needs of the country. A sugar refinery was also completed with a potential production in excess of the needs of the country.

The volume of mineral production in 1950 was said to be four times greater than that of 1938 and the production of manufacturing industry three times greater.

After World War II Albania concluded on Nov. 27, 1946, an agreement with Yugoslavia establishing for 30 years a customs and economic union between the two countries, and the Albanian five-year plan 1947–52 was coupled with a similar Yugoslav plan. At the end of June 1948 Albania denounced the 1946 treaty with Yugoslavia and, despite its territorial isolation, remained in the soviet-dominated area of eastern Europe. After the completion of a short-term two-year plan (1949–50), under which a total of 3,497,900,000 leks was invested in the national economy, Enver Hoxha on Sept. 24, 1951, announced a new five-year plan (1951–55). The total capital investment would amount to 21,000,000,000 leks; *i.e.,* three times as much as was already invested during the period 1946–50. The total value of the industrial and agricultural production of 1955 was expected to be 416% of that of 1938. Among the projects of this plan was an iron and steel works at Valona and a new hydroelectric power station on the Mati river with a yearly generating capacity of 100,000,000 kw.hr.

**Foreign Trade.**—Albania's trade balance between World Wars I and II was persistently adverse (*see* Table III). The country

TABLE III.—*Foreign Trade*
(In thousand gold francs)

| | 1933 | 1936 | 1938 |
|---|---|---|---|
| Imports | 15,638 | 16,778 | 22,980 |
| Exports | 5,746 | 7,435 | 9,750 |

was importing not only manufactures but also cereals and flour (16.5% in 1936–38). Chief exports were: crude petroleum (21.6% in 1938), skins (14.3%), live animals (8.3%), cheese (8.5%) and eggs (8.2%). The imports came chiefly from Italy (26% in 1938), Japan (10%), Great Britain (10%) and Germany (7%), while the exports went to Italy (62%), Greece (25%) and the United States (13%).

After World War II, U.N.R.R.A. supplies aided considerably in the country's reconstruction program. No figures of foreign trade were published after World War II.

**Communications.**—Of the four ports, only Durazzo was fully equipped; Valona, San Giovanni di Medua and Santi Quaranta

(Sarandë) were primitive. There were neither any navigable rivers nor, until World War II, any railways of normal gauge, though during World War I the Austrians had constructed narrow-gauge lines from Scutari to Durazzo, Lushna and Berat, with branches to Tirana, Elbasan and Fieri. In 1951 it was announced that a line of normal gauge was linking Durazzo with Tirana and Elbasan.

The total length of roads available for motor traffic was estimated at 2,000 mi. in 1936 and at 1,766 mi. in 1949. By Dec. 1950 there were about 500 licensed motor cars and 1,200 lorries and buses.

**Finance.**—Albania being a poor country, the state revenues between World Wars I and II were insufficient to meet the cost of administration and development, so that loans had to be raised abroad. After 1925, for political reasons, "abroad" meant Italy. Unfortunately for the protégée the protectress herself was not too rich, and the loans therefore were rather modest. In 1925 an Italian group advanced 50,000,000 gold francs, and from 1931 to 1934 the Italian state granted 10,000,000 gold francs a year. The Italian state granted a further loan of 40,000,000 in 1936 to be expended over a period of years on specified public works.

The National Bank of Albania was formed in Sept. 1925 with an almost exclusively Italian capital of 12,500,000 gold francs. The National created a currency with the Albanian gold franc (franka ara) as a unit. The franc was convertible and had a parity of 22.2215 with the gold pound sterling and 4.566 with the gold U.S. dollar.

TABLE IV.—*Summary of Budget Accounts**
(In million francs)

| | 1933–34 | 1936–37 | 1938–39 | 1939–40 | 1942–43 |
|---|---|---|---|---|---|
| Revenue . . . . . | 24.5 | 18.9 | 28.6 | 40.0 | 74.5 |
| Expenditure . . . . | 27.5 | 18.6 | 28.2 | 40.0 | 74.5 |

*Excluding expenditure on public works effected outside the budget.

The note circulation was of 11,000,000 Albanian francs between 1936 and March 1939, but after the occupation of Albania by the Italian forces inflation started. On Oct. 31, 1939, the note circulation amounted to 27,414,822 francs; there was also a coin circulation of 4,822,530 francs. By Oct. 1940 the note circulation amounted to 51,000,000 francs.

The gold cover remained constant at 7,567,000 francs from 1936 to March 1939, while the reserve in foreign exchange rose during that period from 16,300,000 francs to 45,400,000 francs. In April 1939 the Albanian franc's exchange-rate was fixed at 6.25 Italian lire.

In 1946 a new currency, the lek, was introduced. It was exchanged at the rate of five leks per franc and until June 1948 it was at par with the Yugoslav dinar. In July 1949 a state loan of 250,000,000 leks, the first loan in Albanian history, was launched. On Oct. 1, 1949, all the banknotes issued in 1947 were withdrawn and replaced by new ones, but no information was published as to the amount of the currency circulation.

Five budgets for the period 1933–43 are shown in Table IV. The state budget estimates for 1951 were: revenue 9,500,000,000 leks, expenditure 9,100,000,000 leks. Two-fifths of the expenditure, that is, 3,607,000,000 leks, was earmarked for investment in the national economy, as compared with 2,252,000,000 in 1950. The lek was by now pegged to the soviet rouble. In 1952 the exchange rate was 12.50 leks to the rouble.

**Education.**—Under the Turkish domination which prohibited teaching in the Albanian language, the Albanians remained overwhelmingly illiterate. Independent Albania, especially under King Zog I, succeeded in creating primary and secondary public instruction. In 1939 there were 663 primary schools with 38,988 male and 17,948 female pupils and 19 secondary schools with 4,810 male and 1,425 female pupils. The secondary schools included a French college at Koritsa, a teachers' college at Elbasan, schools of agriculture at Lushna and Kavaja, and a technical school at Tirana. In 1949 the number of elementary schools was estimated at 1,909 with 162,000 pupils: there were also 145 higher elementary and 20 secondary schools with a total of 19,000 pupils. A pedagogical institute was opened at Tirana in 1946.

(X.)

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**ALBANIA,** the ancient name of a district in the eastern Caucasus, consisting, according to Strabo (xi. 4. 1–8), of the valley of the Cyrus (Kur) and the land lying between it and the Caucasus range from Iberia to the Caspian sea. The Albani inhabited also the mountain valleys and the land to the north. (Pliny vi. 39). Dionysius of Halicarnassus quotes a tradition that the name arose because the people were the descendants of emigrants from Alba in Italy. Strabo describes them as tall, well made, and in character simple and honest. They worshipped the sun and, more particularly, the moon, the latter being perhaps identical with the great Nature Goddess of Asia Minor (*see* GREAT MOTHER OF THE GODS). Old age was held in high honour, but it was sacrilege to speak, or even to think, of the dead. The people were nomadic and lived on the abundant natural fruits of the land. In Strabo's time they appear to have been ruled by a single king. The Albani became known to the Romans during Pompey's pursuit of Mithridates the Great (65 B.C.), against which they are said to have opposed a force of 60,000 foot and 20,000 cavalry. Pompey exacted from them a nominal submission, but their independence was not seriously affected by the Romans. In the reign of Hadrian their territory was invaded by the Alani (Th. Mommsen, *Provinces of the Roman Empire,* Eng. trans. 1886), and later they fell under the Sassanid rule. They were driven finally into Armenia by the Khazars and ceased to exist as a separate people. The district subsequently suffered under the successive invasions of Huns, Varangians (who captured the chief town Barda in the 10th century), and Mongols. (*See* CAUCASUS: *History;* ARMENIA.)

**ALBANIAN LANGUAGE.** This Indo-European language is spoken in the mountainous region north of Epirus, south of Montenegro, on the eastern side of the Adriatic, by rather less than a million persons, who have kept to their ancient speech as to their ancient ways.

Apart from a few fragments of the 15th century, the oldest texts belong to the 16th and 17th centuries so that all we have is a modern version not very remote from present day speech. It is therefore difficult to construct an accurate history of the language. From what period Albanian was spoken in its present area and whence it came, cannot be stated with certainty. There is no reason for holding that it came from Thrace and it probably is the continuation of a language which from early times was spoken in this area.

Albanian preserves a number of peculiarities indicating its Indo-European origin, such as the personal pronouns, *ty,* thou; *na,* we; *ju,* you; and verbal forms as *thom,* I say; *thotë,* he says; *thomi,* we say; *thonë,* they say.

It is now modern in type. The article follows the noun. The future is expressed by a periphrasis. I will work is *do të punoj,* literally, there is a will that I should work; or *kam me punue*=I have to work, as in the French, *travaillerai.*

A few indigenous words come directly from the Indo-European stock such as, in the northern dialect (called Guègue) *dimen*=winter, plural *dîmna;* and *êmën*=name, plural *êmna.* In Tosk, the southern dialect, these nouns vary in form because *n* between vowels becomes *r,* thus *dimër, dimèra* and *emër, émera.*

The bulk of the vocabulary consists of words borrowed from foreign languages, Albanian being thus a typical Balkan speech in which words have passed from one tongue to another so that we may speak correctly of a Balkan vocabulary despite the fundamental diversity of the individual languages.

Hardly any words can be definitely traced to ancient Greek, whose influence barely reached Albania in classical days. Latin, however, has had a strong influence even from early times and Romance scholars find Latin as well as Romance loan-words. Numerals like *pes*=five, and *dhet*=ten, have an indigenous appearance; but *katrë*=four, and *qind*=one hundred, are evidently from Latin. The Latin *amicus* is *mik, canis* (dog) is *qen. Këndoj,* to recite or read comes from *canto;* as *livroj*=work, comes from *laboro;* and *kujtoj*=think, from *cogito.* Without words taken from Latin, the language would be seriously inadequate. It is a language of interest to the student, for we have a country reached by Roman civilization under the empire where the non-urban population preserved its own speech. The vocabulary is

full of Latin words while the grammar and pronunciation have remained constant to indigenous forms.

Many other influences have been at work on Albanian. Mediaeval and modern Greek have furnished many words, often by indirect routes. Other words are of Slav origin. Thus the word *lypset*="it is necessary," was borrowed from Serbian, which in turn borrowed it from Greek.

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**ALBANUS LACUS** (LAGO DI ALBANO), a lake 12 mi. S.E. of Rome. It is at the bottom of an extinct crater, itself on the margin of the great crater of Albanus Mons (*q.v.*). Fed by subterranean springs, it is 560 ft. deep and the banks 400 ft. over water-level. An outlet was made in 398-397 B.C., because the Delphic Oracle said Veii could be taken only when the waters reached the sea; it is still in use and is rock-hewn, 1 mi. long, 6 ft. high and 4 ft. broad with vertical shafts and a sluice chamber. (*See* ALBA LONGA.)

**ALBANUS MONS** (mod. *Monte Cavo*), the highest point of the volcanic Alban hills, about 13m. S.E. of Rome, 3,115ft. above sea-level. It is on the inner crater rim, while Tusculum and Algidus Mons are on the earlier outer crater, about 7m. wide. Upon the Mons Albanus stood the temple of Jupiter Latiaris, where the annual festival of the Latin League was held.

Little was left of it even in the 17th century, and the charge generally brought against Cardinal York of having destroyed it to build the monastery on the summit cannot be maintained. It is very probable that it was not a large temple (of which indeed no traces have been found) but a precinct containing a number of small shrines. On the other hand, a little below the summit 16 large drums of columns, some four feet in diameter, were found, and probably belonged to some other temple. The road which ascended to the temple is still well preserved for the greater part of the way from Aricia, where it began. It was called Via Triumphalis, because minor triumphs were held on the Mons Albanus.

**ALBANY, DUKES OF.** The territorial designation of Albany was formerly given to those parts of Scotland to the north of the firths of Clyde and Forth. The title of duke of Albany was first bestowed in 1398 by King Robert III. on his brother, Robert Stewart, earl of Fife (*see* I. below); but in 1425 it became extinct. The dukedom was re-created, *c.* 1458, in favour of Alexander Stewart, "lord of Annandale and earl of March" (*see* II. below), whose son and successor (*see* III. below) left no legitimate heir. The title of duke of Albany was next bestowed upon Henry Stuart, commonly known as Lord Darnley, by Mary, queen of Scots, in 1565. From him the title passed to his son, James VI. of Scotland and I. of England. The title was by him given, at his birth, to Charles, his second son, afterwards King Charles I. By Charles II. it was again bestowed, in 1660, on James, duke of York, afterwards King James II. On July 5, 1716, Ernest Augustus, bishop of Osnaburgh (Osnabrück) (1674–1728), youngest brother of King George I., was created duke of York and Albany, the title becoming extinct on his death without heirs in 1728. On April 1, 1760, Prince Edward Augustus, younger brother of King George III., was created duke of York and Albany; he died without heirs on Sept. 17, 1767. On Nov. 29, 1784, the title of duke of York and Albany was again created in favour of Frederick, second son of George III., who died without heirs on Jan. 5, 1827. On May 24, 1881, Prince Leopold, youngest son of Queen Victoria, was made duke of Albany (*see* IV. below).

I. ROBERT STEWART (*c.* 1345–1420), duke of Albany, regent of Scotland, was a natural son of King Robert II. He was made high chamberlain of Scotland in 1382, and gained military reputation by leading several plundering expeditions into England. In 1389 he was chosen governor of Scotland by the estates; and he retained the control of affairs after his brother John became king as Robert III. in 1390. In April 1398 he was created duke of Albany; but in the following year his nephew David, duke of Rothesay, the heir to the crown, succeeded him as governor, although the duke himself was a prominent member of the advising council. Uncle and nephew soon differed, and in March 1402 the latter died in prison at Falkland. It is not certain that Albany was responsible for the imprisonment and death of Rothesay, whom the parliament declared to have died from natural causes; but the scanty evidence points in the direction of his guilt. Restored to the office of governor, the duke was chosen regent of the kingdom after the death of Robert III. in 1406, as the new king, James I., was a prisoner in London; and he took vigorous steps to prosecute the war with England, which had been renewed a few years before. He suppressed a formidable revolt led by Donald Macdonald, second lord of the isles, who claimed the earldom of Ross and was in alliance with Henry IV. of England. The duke died at Stirling Castle in Sept. 1420, and was buried in Dunfermline abbey. His son, Murdac (or Murdoch) Stewart, succeeded him as duke of Albany and regent, but the dukedom became extinct at his execution in 1425.

*See* John of Fordun, *Scotichronicon,* continued by Walter Bower, edited by T. Hearne (1722); Andrew of Wyntoun, *The Orygynale Cronykil of Scotland,* edited by D. Laing (1872–79); and P. F. Tytler, *History of Scotland* (1850). *See* also Sir W. Scott's *Fair Maid of Perth.*

II. ALEXANDER STEWART (*c.* 1454–1485), duke of Albany, was the second son of James II., king of Scotland, by his wife, Mary, daughter of Arnold, duke of Gelderland. Created duke of Albany before 1458, he also received the lordship of the Isle of Man, and was afterwards captured by an English ship when journeying to Gelderland in 1468. He was soon released, and as he grew to manhood began to take part in the government and defense of Scotland, being appointed in quick succession high admiral, warden of the marches, governor of Berwick and lieutenant of the kingdom. He quarrelled with his brother, king James III., and carried on a series of intrigues with the English, who supported his pretensions to the Scottish crown. He was sentenced to death in 1483 during his absence in England. He died in France two years later.

III. JOHN STEWART (*c.* 1481–1536), duke of Albany, regent of Scotland, was born about 1481. In 1515, at the request of the Scottish Parliament, Albany came to Scotland, was inaugurated regent in July, and proceeded to organize resistance to the influence of England and of Margaret Tudor, the queen dowager, sister of Henry VIII. In August he seized the latter and her children at Stirling, and subsequently was occupied in suppressing the rebellion of the Homes, Angus (the second husband of Margaret), and James Hamilton, earl of Arran; Alexander, third lord Home, being beheaded in Oct. 1516. Albany was declared on Nov. 12 heir to the throne, and on June 6, 1517, he returned to France. In August he concluded the treaty of Rouen, by which the alliance between France and Scotland was renewed, and a daughter of Francis I. was to marry James V. Meanwhile disorders had broken out owing to the rivalry between Angus and Arran. Francis I. had secretly engaged himself to Henry VIII. not to allow Albany's departure from France, but he returned at the close of 1521 and immediately became the object of Henry VIII.'s and Wolsey's attacks. He reconciled himself temporarily with Margaret, supported her divorce from Angus, and was now accused by the English Government of harbouring schemes of marrying her himself. This was denied by the Scots, and Henry's demand for the regent's dismissal refused. War broke out in 1522, and in Sept. Albany advanced to within four miles of Carlisle with a large army. The Scots, however, showed unwillingness to fight outside their own frontiers, and Albany disbanded his troops and departed to France, leaving the borders exposed to the enemy. On Sept. 25, 1523, he once more landed in Scotland, bringing with him supplies from France and a considerable body of troops, and on Nov. 3, after an unsuccessful attack on Wark, retreated hastily, and quitted Scotland finally on May 20, 1524. On July 30 his regency was terminated by the declaration of James V. as king. Between 1530 and 1535 he acted as French ambassador in Rome, conducted Catherine de' Medici, his wife's niece, to Paris on her marriage to Henry (afterwards Henry II.) in 1534, and negotiated the marriage of James V.

The regent Albany was a singularly unfortunate commander in the field, but a successful ruler and administrator, and the Scottish court of session owed to him its institution. But he regarded himself more the subject of the king of France than of the king of Scotland, subordinated the interests of the latter state to the former, and disliked his official duties in Scotland.

IV. Leopold George Duncan Albert (1853–1884), duke of Albany, youngest son of Queen Victoria, was born on April 7, 1853. He matriculated at Christ Church, Oxford, in Nov. 1872, and pursued his favourite studies of science, art, and the modern languages. In 1876 he left the university with the honorary degree of D.C.L. On coming of age in 1874, he had been made a privy councillor and granted an annuity of £15,000. He travelled on the continent, and in 1880 visited the United States and Canada. He was a trustee of the British Museum, a bencher of Lincoln's Inn, and continued to take an active part in the promotion of education and knowledge generally. On May 24, 1881, he was created duke of Albany, earl of Clarence, and Baron Arklow. On April 27, 1882, he married Hélène Frederica Augusta, princess of Waldeck-Pyrmont, and his income was raised by parliament to £25,000. His death at Cannes on March 28, 1884, was universally regretted. He left a daughter, born in Feb. 1883, and a posthumous son, Arthur Charles Edward, born on July 19, 1884, who succeeded to the dukedom of Albany, and who, on July 30, 1900, became duke of Saxe-Coburg on the death of his uncle. He abdicated on Oct. 22, 1920.

**ALBANY, LOUISE MAXIMILIENNE CAROLINE,** Countess of (1752–1824), eldest daughter of Prince Gustavus Adolphus of Stolberg-Gedern, was born at Mons on Sept. 20, 1752. In her youth she was a canoness of Ste. Wandru at Mons, but in her twentieth year she was affianced, at the instigation of the Duke of Berwick and with the secret connivance of the French court, to Prince Charles Edward Stuart, "the Young Pretender," self-styled Count of Albany. They were married at Macerata, near Ancona, on Good Friday 1772, and went to live in the old Stuart palace at Rome and later on in Florence.

The marriage was an unhappy one, and in Dec. 1780 Louise fled to a neighbouring convent and threw herself on the protection of her brother-in-law, Henry Stuart, Cardinal York. She had already in Florence formed the acquaintance of the poet Vittorio Alfieri, who now followed her to Rome. In 1784 a legal separation between the Count and Countess of Albany was arranged, and by Charles's death in 1788 Louise found herself free. In company with Alfieri (to whom rumour said she had been secretly married) she now visited Paris and London, and was cordially received at the English court, George III. granting her an annual pension of £1,600 from the privy purse. Returning to Italy, Alfieri and the countess settled at Florence, where the poet died on Oct. 9, 1803 and was buried in the church of Santa Croce beneath Canova's vast monument erected at Louise's expense. The countess continued to reside in the house on the Lung' Arno at Florence, where she held a salon frequented by scientists and men of letters. She died on Jan. 29, 1824 and was buried in Santa Croce.

The countess bequeathed all her property to the companion of her old age, the French painter, François Xavier Fabre, who ultimately gave the greater part of his legacy to the museum of his native town of Montpellier. Two excellent portraits of the Countess of Albany and of Alfieri, painted by this artist, now hang in the Uffizi Gallery at Florence.

Bibliography.—*See* Vernon Lee, *The Countess of Albany* (1884); Marchesa Vitelleschi, *A Court in Exile.*

**ALBANY,** a municipal town in the county of Plantagenet, on Princess Royal harbour, itself an interior basin of King George sound, on the most southerly stretch of the coast, and towards the south-west corner of West Australia. The coast-line, here largely composed of granite, has sunk in recent geological times, giving rise to magnificent inlets which, however, wave action has to some extent already modified by erosion and the deposition of sand. First occupied in 1826, it was later (1889) connected by rail with the existing West Australian railway system and ultimately became the southern terminus of the Great Southern railway. Albany is 352 mi. distant from Perth by rail. Its fine and equable climate (mean annual temp.: 58.6°; mean annual rainfall: *c.* 30″) and its scenery brought it into prominence as a summer and health resort, and for long it was the port of arrival and departure for the mail steamers. A coaling station, importing Newcastle (N.S.W.) coal was established; and industries began to rise and flourish. The development of the ports of Fremantle and Bunbury; the substitution of locally mined (Collie) coal for imported coal; the loss of economic hinterland through the development of the State railway system, and the loss of passenger traffic owing to the completion of the west-east transcontinental line severely affected Albany which suffered a decline; but the development of orchards, timber and wheat in the promising southwestern region of the state offered opportunity for progress. Pop. (1933) 4,076.

**ALBANY,** a city of Georgia, U.S., 170 mi. S.E. of Atlanta, on an elevated plateau at the head of navigation on the Flint river; the county seat of Dougherty county. It is served by the Atlantic Coast Line, the Seaboard Air Line, the Central of Georgia, the Georgia Northern and the Albany Northern railroads and by Eastern Airlines. Pop. (1950) 30,987; (1940) 19,055 by federal census. It is the commercial and social centre of a region which formerly was devoted to cotton raising by Negro tenants on large plantations, but, after the boll weevil reached it about 1915, the region became the world's greatest centre for paper-shell pecan culture; there are more than 70,000 ac. in pecans within a 40-mi. radius of Albany. The region also has small farms with diversified crops. Cotton is still a profitable crop; others are peanuts, cattle, peaches, bright-leaved tobacco, sweet potatoes, watermelons, cantaloupes, hogs, poultry, berries and vegetables.

The city has diversified industries, including peanut and pecan processing plants, a meat-packing plant, farm implement plant, hosiery mills, bottling plants, candy plant and a cotton thread finishing plant.

Albany State college for Negroes is located there. Radium Springs, a resort, is 4 mi. S. of Albany. Turner air force base is located 3 mi. E.

Albany was settled in 1836; planned in 1837 by Nelson Tift from Connecticut; and incorporated in 1838. The commission-city manager form of government was adopted in 1924.

**ALBANY,** the capital of the state of New York, U.S., a city, a port of entry and the county seat of Albany county; on the west bank of the Hudson river, below the mouth of the Mohawk, 145 mi. N. of New York city; at the crossroads between Boston and Buffalo and between Montreal and New York. It is served by the New York Central, the Delaware and Hudson, the West Shore and Boston and Albany railways; by the steamboat lines on the Hudson; and is a terminus of the state barge canal system.

The area is 19.6 sq.mi. The population in 1950 was 134,382; in 1940 it was 130,577 and in 1930 127,412 by federal census.

Albany lies picturesquely on a series of hills rising sharply from the river. Fine specimens of the Dutch and later colonial architecture are still standing. The Schuyler mansion (built 1761) was dedicated in 1917 as a state historical monument. The Van Rensselaer manor house (1765) was moved in 1893 to the campus of Williams college, Williamstown, Mass. On a commanding site of 7.84 ac. stands the state capitol (300 by 400 ft.) of Maine granite, which was built (1867–98) at a cost of $25,000,000. Across the square is the beautiful colonnaded state education building, which also houses not only the state department of education, but also the state library (established 1818) of 630,000 vol. and the state museum, which has a fine collection of Indian relics. The present city hall (erected 1882), the fifth which the city has used, is a French Gothic structure of pink granite. Many of the schools, banks, hotels, clubs and churches have architectural beauty and dignity. The State Bank of Albany (1803) is probably the oldest building in America continuously used for banking purposes. There are 20 parks, of which Washington and Lincoln are the largest. A zoning ordinance was adopted in 1924 as a foundation for a comprehensive program of building and improvement. Converging railways, water routes and highways, together with a

population of 30,000,000 within a radius of 200 mi., make Albany an important distributing point. Traffic facilities were greatly improved by the New York Central's construction of the "Castleton cut-off" (opened 1924), which diverted rail traffic from the steep grades and congested trackage at Albany across a new bridge 10 mi. below the city. The same company also built a vast terminal classification yard at Selkirk west of the river, with a capacity for 20,000 cars. Albany has a municipal airport, and the deepening of the Hudson (authorized 1925), to give a 27-ft. channel from New York city, made it a very busy seaport.

The Albany port district, embracing the city of Albany, the city of Rensselaer and adjacent lands and water in the Hudson river, is in charge of a commission appointed by the governor. Ground was broken for port development in 1926. Albany has many and diverse industries. It has about 200 factories, with an aggregate output valued at more than $60,000,000 and products ranging from such staples as stoves, chemicals, textiles and paper, to billiard balls, checkers, dominoes, axle grease, paper towels, college caps and gowns and college pins. About 1,500 men are employed in printing plants. Albany is an important educational centre. The public-school system includes 28 elementary schools, vocational schools for boys and girls, junior high and high schools. The Catholic system consists of 18 parish schools (including 4 high schools), 2 academies and 2 institutions of college grade. There are several private academies. The state college for teachers (opened 1844) has an enrolment of approximately 1,500. The professional schools of Union university, which has its undergraduate college in Schenectady, are situated here; viz., the Albany College of Pharmacy (established 1881); the Albany Law school (1851); and the Albany Medical college (1839).

The Dudley observatory, founded in 1852 as the result of an abortive attempt to establish a national university in Albany, is also affiliated with Union university. Training schools for nurses are maintained by four hospitals. There are two daily papers, the *Knickerbocker News* (1842) and the *Times-Union* (1853).

Albany was probably the second permanent settlement within the borders of the 13 Colonies. Its authentic history dates from 1614, when the agents of the United New Netherland company built a small fort on Castle (now Westerlo) Island, which they occupied for three years as a trading post. In 1624 colonization was begun by the newly organized Dutch West Indian company. Eighteen families of Dutch Walloons arrived; Fort Orange was built on a hill near the present site of the capitol, and the little settlement around it became known as Beverwyck. In 1629 the Dutch government granted to Kiliaen van Rensselaer, a diamond merchant of Amsterdam, a large tract of land (ultimately 1,093 sq.mi.) on both sides of the river, centring at Fort Orange, for a patroonship. His grant was named Rensselaerswyck. The colonists he sent over were capable and industrious, and the settlement prospered. In 1652 Peter Stuyvesant, after a lengthy controversy with the director of Rensselaerswyck, established Beverwyck as an independent village. When Fort Orange was surrendered to the English (Sept. 24, 1664) Beverwyck was named Albany, one of the titles of the duke of York (afterward James II). In 1673–74 Albany again came under Dutch control for about a year, during which time it was called Willemstadt. Meanwhile the Van Rensselaer family in the Netherlands was trying to obtain from the duke of York a patent for the colony which would restore to them the ownership of the former village of Beverwyck. The application came finally to Gov. Thomas Dongan, who declined to grant it because he "did not think it convenient that the second town in the government should be in the hands of private men." The Van Rensselaers thereupon relinquished their claims to Albany, and received a patent (1685) which erected the colony of Rensselaerswyck into an English manor. On July 22, 1686, Governor Dongan granted to Albany a city charter, by which all vacant and unappropriated lands within its limits were vested in the mayor, aldermen and commonalty of the city, thus ending the jurisdictional disputes. The first mayor, appointed by the governór, was Peter Schuyler (1657–1724). In 1643, according to Father Isaac Jogues, the settlement consisted of 25 or 30 houses, built along the river; in 1695 the Rev. John Miller found 200 houses; at the first federal census (1790) the population was 3,498; by 1850 it had reached 50,763, 1910, 100,253 and in 1950, 134,382. As late as 1750 a Swedish naturalist, Peter Kahn, who wrote a vivid description of the city, found the language and manners still Dutch, though the dress was in English style. Albany became the permanent state capital in 1797.

Its strategic position at the gateway of the Iroquois country and at the head of navigation on the Hudson made Albany highly important throughout the colonial period. In 1689 the first intercolonial convention was held there, when delegates from Massachusetts Bay, Plymouth, Connecticut and New York met to treat with representatives of the five nations and to plan a system of defense. The Albany congress of 1754 was a similar and more important gathering, including commissioners also from New Hampshire, Rhode Island, Pennsylvania and Maryland, which met in anticipation of renewed hostilities with the French. It secured from the Indians assurances of their continued support, and adopted a plan (proposed by Benjamin Franklin) for "one general government" of the English Colonies for purposes of common defense. The "Albany plan," though disapproved both by the home government and by the Colonies, paved the way for the congress of 1765 and the Continental Congress of 1774. During the Revolution the British looked upon Albany as "a capital object to be subdued," and it was the objective of Gen. John Burgoyne's expedition which ended with the battle of Saratoga. In 1839 it became the centre of the "Anti-Rent War," which was precipitated by the death of the last patroon and the attempt of his heirs to collect overdue rents, and was not entirely settled until 1847. The first newspaper, the *Gazette*, was founded in 1771. The *Argus*, founded in 1813, was long the organ of the coterie of New York politicians known as the "Albany regency," and was one of the most influential Democratic papers in the country. The *Evening Journal*, founded in 1830 and edited for 35 years by Thurlow Weed, was equally influential as an organ of the Whig and later of the Republican party.

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**ALBANY,** a city of Oregon, U.S., on the Willamette river, 77 mi. S. of Portland; the county seat of Linn county. It is on U.S. highways 20 and 99E and is served by the Southern Pacific and the Oregon Electric railways. The population was 10,076 in 1950 and 5,654 in 1940. Albany is an important railway centre. It manufactures furniture, boxes, sashes and doors, plywood, condensed and powdered milk. There are three sawmills, canneries, flour mills, frozen food plants, pipe and building-block manufacturing plants and meat-packing plants, a foundry, machine shops and creameries. The U.S. bureau of mines operates an important zirconium research plant there. Albany is a large turkey-shipping point and is an important seed centre. The city of Albany was settled in 1846 and incorporated as a city in 1865.

**ALBANY,** a river of Canada, rises in Lake St. Joseph in 91° 25′ W. and 50° 55′ N., and flows east-northeast into James bay; length, 610 mi.; navigable for nearly half its length, to Martin's falls. There are four Hudson's Bay company posts on its banks, including Fort Albany at its mouth. The Ogoki and Kenogami rivers are the principal tributaries.

**ALBANY CONGRESS,** a gathering of delegates from several American Colonies important for the plan which it devised for colonial union. In accordance with instructions from the British board of trade (Sept. 18, 1753), 25 delegates, representing the four New England Colonies, New York, Pennsylvania and Maryland, met at Albany, N.Y., on June 19, 1754, for the express purpose of formulating a concerted Indian policy. It was early apparent to the delegates that the question of colonial union was of even greater importance than a common Indian policy, so a committee was appointed to prepare a plan. The plan reported was chiefly the work of Benjamin Franklin and was unanimously adopted. It provided for a president-general to be appointed by the crown, and for a grand council to be elected by the colonial assemblies. This grand council was empowered to raise and pay soldiers, to build forts and to equip vessels to guard the coasts. The necessary funds were to be raised by the grand council, which was to have power to levy taxes and impose general duties. In this grant of power is seen the first suggestion of the important federal principle which underlies the entire federal structure in the United States—the right of the general govern-

ment to operate directly upon individuals. The plan was too comprehensive to suit the various colonial governments, which either rejected or failed to ratify it. It was never formally presented to the British government. As a result of this unfavourable action by the colonial governments the Albany congress failed to solve either the question of colonial union or of joint Indian policy.

*See* R. Frothingham, *Rise of the Republic of the U.S.* (1881); G. L. Beer, *British Colonial Policy, 1754–1765* (1907); E. B. Greene, *Foundations of American Nationality* (1922); J. T. Adams, *Revolutionary New England* (1923). (C. C. TA.)

**ALBANY REGENCY,** the name given to a coterie of politicians who from about 1820 to 1854 largely controlled the machinery of the Democratic party in the state of New York. The members of this group constituted the first highly effective U.S. political machine. They derived their power chiefly from their great personal influence and political sagacity. On the whole they actively opposed political corruption, though they always acted on the principle, first stated in 1833 by one of their ablest leaders (Marcy), that "to the victors belong the spoils." Among the members of this unofficial body, whose headquarters were at Albany, were Martin Van Buren, W. L. Marcy, Silas Wright and John A. Dix. About 1848 the opponents of the group began to adopt similar tactics, soon dividing the Democratic party into irreconcilable factions, and thereafter the prestige of the "regency" rapidly waned.

**ALBATEGNIUS** (MOHAMMED BEN GEBIR AL BATANI, commonly called ALBATEGNICES) (*c.* 850–929), an Arab prince and astronomer, was born at Batan in Mesopotamia. From his observations at Aracte and Damascus, where he died, he was able to correct some of Ptolemy's results, previously taken on trust. He compiled new tables of the sun and moon, long accepted as authoritative, discovered the movement of the sun's apogee, and assigned to annual precession the improved value of 55″. Perhaps independently of Aryabhatta (born at Pataliputra on the Ganges A.D. 476), he introduced the use of sines in calculation, and partially that of tangents. His principal work, *De Motu Stellarum*, was published at Nuremberg in 1537 by Melanchthon, in a blundering Latin translation by Plato Tiburtinus (*c.* 1116), annotated by Regiomontanus. A reprint appeared at Bologna in 1645. The original manuscript is preserved at the Vatican; and the Escorial library possesses in manuscript a treatise of some value by him on astronomical chronology.

*See* Houzeau, *Bibliographie astronomique,* i, 467; M. Marie, *Histoire des sciences,* ii, 113; R. Wolf, *Geschichte der Astronomie,* p. 67; Delambre, *Hist. de l'astr. au moyen âge,* ch. ii; *Phil. Trans.,* 1693 (913), where E. Halley supplies corrections to some of the observations recorded in *De Motu Stellarum.*

**ALBATROSS,** any one of some dozen species of very large sea birds related to the petrels (*q.v.*) and constituting the order Diomedeidae in the order Procellariiformes. They have heavy bodies, exceptionally long narrow wings, a short tail in all except the sooty albatrosses (*Phoebetria*), short legs placed far back, large webbed feet without hind toe and a large stout hooked bill covered with horny plates, with a tube-nostril on either side of the upper mandible. They inhabit colder oceans, often at great distances from land, nine species in lower parts of the southern hemisphere, one over cold waters off Peru and Ecuador and three in the north Pacific. The larger species (44–53 in. long) are known to sailors as gony, the smaller (28–37 in.) as mollymawk or mallemuck.

The largest species is the wandering albatross (*Diomedea exulans*), one of the two largest and most famous of flying birds, the other being the condor (*q.v.*) with smaller wing-spread but heavier body. The great wandering albatross flies over circumpolar southern seas, 30° to 60° S., and breeds on subantarctic islands. It attains a length of 53 in., yellowish bill 7 in., wing-spread 11.5 ft., and a weight of 20 lb. It is white, with faint wavy black bars on the mantle, and black tips to wings and tail. The sailor's superstition about killing an albatross was used in Coleridge's *Rime of the Ancient Mariner.* In regions of strong winds or gales albatrosses do not flap their wings but glide for hours low over rolling seas, settling on the water to feed on cuttlefish and squid, taking flight by fully extending their wings and running against the wind. With salt pork as bait, they are caught on hook and line, cannot take flight from the deck, and become seasick with the roll of the ship. They rarely approach land, and breed on remote oceanic islands, rocky and inaccessible or low of coral sand. Some species have elaborate courtship performances. A single egg, dull white finely speckled near the larger end with brown, is laid December to February (August to January in all others but one) in a depression on the ground, or on trampled grass and debris; both parents incubate the egg, two to three months in different species, and care for the young, which is fed for many months on regurgitated food. The great royal albatross (*D. epomophora*), of Tierra del Fuego and islands south of New Zealand, has bulbous nostril-tubes and is only slightly smaller and whiter than the wandering albatross.

Others of cold southern seas include the white-capped albatross (*D. cauta*), breeding in the southwest Pacific from southeastern Australia to the Chatham Islands and ranging east to western and southeastern South America and west to the Cape of Good Hope; and the black-browed albatross (*D. melanophris*), circumpolar to the pack-ice, breeding on subantarctic islands. Ranging with the latter is the gray-headed albatross (*D. chrysostoma*), slightly further north the yellow-nosed albatross (*D. chlororhynchos*), head white, of the south Atlantic and Indian Oceans, and Buller's albatross (*D. bulleri*), with gray head and white fore-cap, of the south Pacific; the last three have a yellow stripe along the top of the black bill and are known as yellow-nosed mollymawks.

Of the three albatrosses that breed on islands west of Hawaii, and range far over the north Pacific and southwestward, the largest is the short-tailed albatross (*D. albatrus*), 37 in., with pink bill and pale feet, the only white-bodied north Pacific species, now nearly extinct. The Laysan albatross (*D. immutabilis*), length 32 in. and wing-spread 6 ft. 8 in., with sooty mantle and pink feet, is famous for its courtship dance. The commoner, slightly smaller black-footed albatross (*D. nigripes*), 28 in., is sooty brown with whitish around the base of the bill. The Galapagos or waved albatross (*D. irrorata*), mainly dark with white head and neck, breeds in May and June on Hood Island and feeds over the cold Humboldt current off Peru.

Two southern species (*Phoebetria*) have dark plumage, an incomplete white eye-ring and a longer wedge-shaped tail. They are more slender, graceful and skilled in flight. The sooty albatross (*P. fusca*), mainly sooty brown, breeds in the cool southeastern Atlantic, and ranges to South America and the Australian seas; the gray-mantled sooty albatross (*P. palpebrata*), pearl gray with darker head, wings and tail, is circumpolar south of 35° S., and northward with the cold waters along western South America. (G. F. Ss.)

**ALBAY** (now Legaspi), a municipality (with administrative centre and 19 *barrios* or districts) and capital of the province of Albay, Luzon, P.I., near an inlet on the west shore of the gulf of Albay, about 200 mi. by road S.E. of Manila. Pop. (1939), 41,468, of whom 21,015 were males and 87 were white.

The municipality lies on level ground near the south base of Mayon volcano (7,943 ft., surmounted by the most perfect known volcanic cone) from which it is sheltered by the Linguin hills. Formally established in 1636 under the name of Albay, it had by 1649 a population of about 1,200, a Roman Catholic church, a fortified structure and a partly completed wall. Destructive eruptions of the volcano occurred from time to time, notably in Feb. 1815, when much of the centre and surrounding district was submerged and about 1,200 inhabitants were killed. There was another less violent eruption in 1897. The town was partly destroyed by insurgents in 1900, but civil government under the United States was established in the following year. It was a point of debarkation for the Japanese forces which invaded Luzon and advanced on Manila from the south in Dec. 1941. Under the stable U.S. regime the municipality grew steadily in importance and in the range of its industries. It has railway and steamship connections with the important Philippine towns, and automobile roads lead to various parts of the province as well as to Manila;

it is the centre and exporting point of one of the most productive regions of abacá (Manila hemp). Other native fibres are produced and woven into fabrics for export as well as for home consumption. Palay (rice), maize (corn), copra and sugar are also grown. Of the inhabitants aged 6 to 19, inclusive, 33.1% in 1939 attended school, while 54.3% of the population 10 years old and over was literate. The municipalities of Albay and Legaspi were merged in 1907, and the name was changed to Legaspi in 1925. The vernacular is Bikol. The number of parcels of land declared for taxation in 1938 was 9,039 and the number of owners, 6,294.

**ALBEDO** (from Lat. *albus*, white), "whiteness," a word used principally in astronomy for the measure of reflecting power. A body shining by reflected light is said to have albedo ½ if it reflects (or scatters outwards) half the light incident on it. The albedo for visual light of the cloud-covered planets (Venus, Jupiter, Saturn, Uranus, Neptune) ranges from 0.56 to 0.73; of the earth 0.44; Mars 0.15; Moon 0.07. (*See* H. N. Russell, *Astrophysical Journal*, vol. xliii. p. 173.)

**ALBEMARLE, WILLIAM DE FORS** or **DE FORTIBUS,** EARL OF (d. 1242), was a great-grandson of King Stephen and a son-in-law of William of Blois. He is described by Bishop Stubbs as a "feudal adventurer of the worst type." He was one of the executors of Magna Carta, but frequently changed sides in the civil war that followed, his general aim being to revive the power of the feudal barons. In 1221, 1222 and 1223 he was in revolt, although in each case he was compelled to submit, and was twice excommunicated. He died at sea on his way to the Holy Land on March 26, 1242.

ALBEMARLE, GEORGE MONK OR MONCK, 1st duke of. *See* MONK.

ALBEMARLE, ARNOLD JOOST VAN KEPPEL, 1st earl of (1669–1718), was born in Holland, and accompanied William III. to England in 1688. He was created earl of Albemarle in 1697. The confidant of the king, he returned to Holland at his death, and became a general of horse in the Dutch army. He joined the allied forces in 1703, fought at Ramillies, Oudenarde, and the siege of Lille. He led Marlborough's second line in 1711.

ALBEMARLE, GEORGE THOMAS KEPPEL, 6th earl of (1799–1891), British general, served in the campaign of Waterloo. He was aide-de-camp to the marquess of Hastings in India, returning home in 1823 by way of Persia and St. Petersburg (now Leningrad). He wrote a narrative of the journey, *Journey from India to England* (1825). Gen. Keppel sat in the first reformed parliament as a member for East Norfolk (1832–35) and for Lymington (1847–49). He succeeded to the title in 1851.

*See* his *Fifty Years of My Life* (1875).

**ALBEMARLE AND CHESAPEAKE CANAL,** in the United States, connecting Norfolk, Va., with Currituck Sound, N.C., is a portion of the inland navigation between New York, Philadelphia, Baltimore and North Carolina and is connected with the Chesapeake and Delaware and Raritan canals. It is 11.2 mi. long, 80 ft. wide, 12 ft. in depth and has one lock. Its capacity is steamers of approximately 800 tons, drawing 11 ft. of water. The canal was opened in 1860, and the cost of construction was $1,641,363.

**ALBEMARLE SOUND,** a large inlet on the Atlantic coast of North Carolina, U.S.A. It has an east and west direction extending along the 36th parallel of north latitude, a length of about 50 mi., and a breadth of from 5 to 15 miles. The depth varies from a few feet to 20 ft. or more. Albemarle is separated from the Atlantic by a long narrow barrier beach. From the northeast end of the Albemarle the long, narrow arm called Currituck sound extends northward about 40 mi. to and beyond the Virginia border. On the southeast Albemarle is connected with Pamlico sound by Croatan sound, and also by a narrower channel, Roanoke sound, separated from the former by Roanoke Island. From Albemarle sound project many bay-like arms, commonly called rivers, because they serve as the mouths of streams; but they are true bays, having a breadth of several miles and a depth about equal to that of the sound. Roanoke river (*q.v.*) is the most important stream emptying into it. Albemarle is connected with Norfolk, Va., harbour partly by natural and partly by artificial waterways (Dismal Swamp canal and the Albemarle and Chesapeake canal), thus forming an important link in the great inland waterway extending from Massachusetts to Beaufort, North Carolina.

**ALBENGA,** town and episcopal see, province of Savona, Italy, on the northwest coast of the Gulf of Genoa, 52½ mi. S.W. of Genoa by rail. Pop. (1936), 5,848 (town), 10,698 (commune). Albenga is the ancient *Album Ingaunum* or *Albingaunum,* the chief town of the Ingauni, whose territory reached as far as Genoa. An inscription records the restoration of the walls, forum, harbour, etc., by Constantius A.D. 354. To the east is a well-preserved Roman bridge, Ponte Lungo, nearly 500 ft. long and 11½ ft. wide, with 10 arches, each with a span of 37 ft. To the south is a conspicuous rectangular pillar, 27 ft. high, probably marking a tomb. A good brick Gothic cathedral has an interesting octagonal baptistery (8th or 9th century).

**ALBENIZ, ISAAC** (1860–1909), Spanish pianist and prolific composer, who only towards the close of his career found his true métier and wrote the works which give him his chief claim to remembrance. These were his brilliant and fascinating pianoforte pieces, such as the suite *Iberia,* reproducing the rhythms and other characteristic features of Spanish popular music. He wrote also a number of works for the stage, including a comic opera, *The Magic Opal,* produced in London, and a more ambitious work, *Pepita Jiménez,* but these were of less account.

**ALBERONI, GIULIO** (1664–1752), Spanish-Italian cardinal and statesman, the son of a gardener, born near Piacenza, probably at the village of Fiorenzuola. He took priest's orders, and found his way to Rome in attendance on the son of a bishop. During the War of the Spanish Succession Alberoni rendered substantial services to the Duke of Vendôme, commander of the French forces in Italy, and in 1711 he followed him into Spain as his secretary. Two years later Alberoni was appointed consular agent for Parma at the court of Philip V. of Spain, and helped to arrange the king's marriage with Elizabeth Farnese of Parma, by whose influence he was made a member of the king's council, bishop of Malaga, and in 1715 prime minister. Alberoni's foreign policy was to undo the work of the Treaty of Utrecht. He desired to gain the succession of Elizabeth to Parma and Piacenza, then in the hands of Austria. To this end he made hurried attempts to reform the administration and the military and financial organization of Spain. But the impatience of Elizabeth left him no time to mature his plans. In 1718 Alberoni equipped a small expedition to help the Scottish Jacobites against George II, but the fleet was wrecked on its way from Cadiz. The Spanish ambitions in Italy led to the Quadruple Alliance of England, France, Austria and Holland, all of which needed a long period of peace for recovery from the last war, and after the landing in 1718 of Spanish troops at Palermo, French armies and English ships invaded Spain. After the Spanish collapse Alberoni was exiled, and went to Italy, where he took refuge in the Apennines, Pope Clement XI, who was his bitter enemy, having ordered his arrest. On the latter's death Alberoni appeared at the Conclave and took part in the election of Innocent XIII (1721), after which he was imprisoned for a time by the Pope, at Spain's demand. At the next election, he was himself proposed for the papal chair, and secured 10 votes at the Conclave which elected Benedict XIII. He died on June 16, 1752. Alberoni left a number of manuscripts, but the genuineness of the *Political Testament* published under his name at Lausanne in 1753 has been questioned.

An *Histoire du Cardinal Alberoni* up to 1719 was published by Jean Rousset de Missy at The Hague in 1719. A laudatory life, *Storia del Cardinale Giulio Alberoni,* was published by Stefano Bersani, a priest educated at his college, at Piacenza, in 1861. *Giulio Alberoni e il suo secolo,* by Giovanni Bianchi (1901), is briefer and more critical. *See* also *Lettres intimes de J. Alberoni,* edited by M. E. Bourgeois (1892).

**ALBERT I** (1875–1934), king of the Belgians, was born at Brussels, April 8, 1875, the younger son of Philip, count of Flanders (1837–1905), who was a brother of Leopold II, and Princess Marie of Hohenzollern. The other children of this marriage were Baldwin (b. 1869), Henriette, afterward duchess of Vendôme (1870–1948), a daughter who died in infancy and Josephine, afterward Princess Charles of Hohenzollern (b. 1872).

The premature death of Prince Leopold, only son of Leopold II, on Jan. 22, 1869, made Prince Baldwin heir presumptive to the Belgian crown, but on his death on Jan. 23, 1891, Prince Albert

became next in the line of succession. He was carefully educated, and showed a marked taste for engineering and mechanics, studying both naval and aerial construction. He received his training in military matters at the École Militaire under Gen. Jungblut, and also became a thorough sportsman, taking much interest in mountaineering and later in aviation. He served as an officer in the Grenadier regiment. On Oct. 2, 1900 he was married at Munich to Elisabeth (b. July 25, 1876), second daughter of Duke Charles Theodore of Bavaria. Three children were born of this marriage: Leopold, duke of Brabant (b. Nov. 3, 1901); Charles, count of Flanders (b. Oct. 10, 1903) and Marie José (b. Aug. 4, 1906). *See* LEOPOLD III.

Prince Albert also travelled widely, paying a visit to America in 1898, and in 1908 visiting England in order to study naval construction. In April 1909 he went to the Belgian Congo. Starting from the Cape, he visited the Cape province and the Transvaal, going from there to Elisabethville. Thence he traversed the Katanga mineral region and followed the course of the Congo to its mouth. He returned to Belgium in August, and three months later King Leopold died.

On Dec. 23, 1909 Prince Albert took the oath of fidelity to the Belgian constitution, and became king under the name of Albert I. In his speech from the throne, the king emphasized his care for the people's welfare in the words: "Our prosperity depends upon the prosperity of the masses." He occupied himself more especially with the organization of the army, and in May 1913 gave his assent to the law which was designed to secure for Belgium an army of 350,000 men. He also interested himself in various social and legal reforms, while his scientific tastes did not prevent him becoming a friend of art and literature. The economist Waxweiler, the poet Verhaeren and the painter Laermans were on friendly terms with the royal family, the latter receiving personal attention from the queen when he was threatened with the loss of his sight.

Albert was anxious to preserve friendly relations with neighbouring States, and after 1910 paid official visits both to Berlin and Paris. On Nov. 5 and 6, 1913, the king, who had been appointed honorary colonel of the regiment of Hanover Dragoons, visited Germany for the second time. At a reception in Potsdam, the Emperor William II. and Gen. von Moltke informed him that they considered war with France imminent. The king gave warning of this to the French ambassador in Berlin through his own minister plenipotentiary, Baron Beyens. On July 31, 1914, when the European crisis came to a head, the king wrote a personal letter to the German emperor, reminding him of the respect due to Belgian neutrality. Germany replied by the ultimatum of Aug. 2, which in turn was answered by a *fin de non recevoir* and hostilities began. The king took command of the troops and established his headquarters first at Louvain and afterwards at Antwerp. He directed in person the first advance from Antwerp towards Louvain, which was intended to relieve the French and British armies engaged with the forces of Kluck and Bülow. After the fall of Antwerp, the king and queen sent their children to England, while they themselves accompanied the retreating army; when it came to a halt on the Yser they took up their residence at Furnes. From Oct. 17 to 24 the Belgian army, under the king's command, withstood the German invasion without any Allied assistance. During the whole of the war he remained with the troops, having his headquarters at La Panne, where he was exposed to the risk of enemy bombardments. He made continual visits to the front-line trenches, and even surveyed the enemy's lines from an aeroplane. The queen remained with him, acting as a nurse in the Hôpital de l'Océan at La Panne. She also interested herself deeply in the welfare of the soldiers in the trenches, and superintended the establishment of canteens and aid posts. Prince Leopold, King Albert's elder son, lived by his father's wish, the life of a simple soldier in the 12th Regiment.

When the general offensive of Oct. 1918 was undertaken, Albert was appointed commander of the northern army groups, consisting of both Belgians and French, which captured the forest of Houthulst, "the Flandernstellung," Thourout, Ostend and Bruges, and forced the passage of the Lys. On Nov. 11, 1918 the king and queen made their entry into Ghent, and on Nov. 22 into Brussels, being received with enormous enthusiasm. Even before the signing of the Armistice the king had summoned at Lophem a number of politicians and had arranged a new government containing representatives of the three more important Belgian political parties. After a triumphant reception by parliament, the king made a speech from the throne, in which he urged that all parties should work together for national reconstruction, while, addressing himself to the Allies, he asked for the abolition of Belgian neutrality and of the treaties of 1839 which had left Belgium open to invasion. After the Armistice, King Albert declined the augmentation of his civil list. He occupied himself actively with the improvement of conditions in his country, visiting the devastated areas, and contributing considerable sums to "King Albert's Fund," which was devoted to providing temporary shelter for sufferers from the war.

The king in person presided at the Colonial Congresses of 1920 and 1926 and made important speeches on those occasions. He was actively interested in the development of the Belgian mercantile marine. As before the war, he continued to support the intellectual development of his country. After the war he made official visits to the State universities of Ghent and Liége. In Jan. 1926 King Albert, who had been given honorary degrees by many universities, was elected a member of the *Institut de France*. His constant solicitude for the welfare of his people was shown during the floods which ravaged Belgium in Dec. 1925. On Feb. 17, 1934, while rock-climbing near Namur, King Albert fell and was killed. (*See* BELGIUM.)

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**ALBERT 1.** (*c.* 1250–1308), German king and duke of Austria, eldest son of King Rudolph I., was invested with the duchies of Austria and Styria in 1282. On Rudolph's death in 1291 Albert was obliged to acquiesce in the election of Adolph of Nassau as German king, but in 1298 he mustered sufficient allies to enable him to defeat Adolph at Göllheim, near Worms, was elected king at Frankfort on July 27, and crowned at Aix on Aug. 24. Pope Boniface VIII. declined to recognize him until 1303 when Albert admitted the right of the pope to bestow the imperial crown and promised that none of his sons should be elected king without papal consent. In 1306 he secured the crown of Bohemia for his son Rudolph, but tried in vain to impose his own claims on Thuringia in 1307. His action in abolishing all tolls established on the Rhine since 1250, led to the formation of a league against him by the Rhenish archbishops and the count palatine of the Rhine; but aided by the towns, he soon crushed the rising. He was on the way to suppress a revolt in Suabia when he was murdered on May 1, 1308, at Windisch on the Reuss, by his nephew John, afterwards called the "Parricide," whom he had deprived of his inheritance.

Although a hard, stern man, he had a keen sense of justice when his selfish interests were not involved, and few of the German kings possessed so practical an intelligence. He encouraged the cities, and not content with issuing proclamations against private war, formed alliances with the princes in order to enforce his decrees. The serfs, whose wrongs seldom attracted notice in an age indifferent to the claims of common humanity, found a friend in this severe monarch, and he protected even the despised and persecuted Jews. The stories of his cruelty and oppression in the Swiss cantons first appear in the 16th century, and are now regarded as legendary.

*See* A. L. J. Michelsen, *Die Landgrafschaft Thüringen unter den Königen Adolf, Albrecht, und Heinrich VII.* (Jena, 1860); G. Droysen, *Albrechts I. Bemühungen um die Nachfolge im Reich* (Leipzig, 1862); J. F. A. Mücke, *Albrecht I. von Habsburg* (Gotha, 1866).

**ALBERT II.** (1397–1439), German king, king of Bohemia and Hungary, and (as Albert V.) duke of Austria, was born on Aug. 10, 1397, the son of Albert IV. of Habsburg, duke of Austria

He succeeded to the duchy of Austria on his father's death in 1404, and in 1438 succeeded his father-in-law, Sigismund, as German king, though he does not appear to have sought election.

He was crowned king of Hungary and of Bohemia but was unable to obtain possession of the latter country. His reign, which lasted less than two years, was spent in the defence of Hungary against the Turks. He died at Langendorf on Oct. 27, 1439. Albert was an energetic and warlike prince, whose short reign gave great promise of usefulness for Germany.

*See* W. Altmann, *Die Wahl Albrecht II. zum römischen Könige* (1886).

**ALBERT, FREDERICK AUGUSTUS** (1828–1902), king of Saxony, was born April 23, 1828, being the eldest son of Prince John, who succeeded to the throne in 1854. In 1849 he served as a captain in the campaign of Schleswig-Holstein against the Danes. When the war of 1866 broke out, the crown prince was placed in command of the Saxon forces opposing the Prussian army of Prince Frederick Charles. No attempt was made to defend Saxony; the Saxons fell back into Bohemia and effected a junction with the Austrians. They took a prominent part in the battles by which the Prussians forced the line of the Iser and in the battle of Gitchin. The crown prince, however, succeeded in effecting the retreat in good order, and in the decisive battle of Koeniggraetz (*see* SEVEN WEEKS' WAR) he held the extreme left of the Austrian position with great tenacity. After peace was made and Saxony had entered the North German confederation, he was placed in command of the Saxon army, which had now become the XII. Army Corps of the North German army. He was a firm adherent of the Prussian alliance.

On the outbreak of war in 1870 he again commanded the Saxons, who formed the extreme left of the German army, at Gravelotte, and with the Prussian Guard carried out the attack on St. Privat, the final and decisive action in the battle. In the march towards Paris the crown prince was given a separate command over the 4th army (army of the Meuse) consisting of the Saxons, the Prussian Guard corps, and the 4th (Prussian Saxony) corps. He took a leading part in the operations which preceded the battle of Sedan, the 4th army being the pivot on which the whole army wheeled round in pursuit of MacMahon; and the actions of Buzancy and Beaumont on Aug. 29 and 30 were fought under his direction; in the battle of Sedan itself, with the troops under his orders, he carried out the envelopment of the French on the east and north. Albert had won the complete confidence of the army, and during the siege of Paris his troops formed the north-east section of the investing force. After the armistice he was left in command of the German army of occupation, a position which he held till the fall of the Commune.

On the conclusion of peace he was made an inspector-general of the army and field-marshal. On the death of his father on Oct. 29, 1873, he succeeded to the throne. The king devoted himself mainly to military affairs, in which his advice and experience were of the greatest value to the German army in general. In 1897 he was appointed arbitrator between the claimants for the principality of Lippe. King Albert married in 1853 Carola, daughter of Prince Gustavus of Vasa, and granddaughter of the last king of Sweden of the house of Holstein. He died June 10, 1902.

**ALBERT** (1522–1557), prince of Bayreuth, surnamed THE WARLIKE, and also ALCIBIADES, was a member of the Franconian branch of the Hohenzollern family. His restless and turbulent nature marked him out for a military career; and having collected a small band of soldiers, he assisted the emperor Charles V. in his war with France in 1543. Sharing in the attack on the Saxon electorate, Albert was taken prisoner at Rochlitz in March 1547 by John Frederick, elector of Saxony, but was released as a result of the emperor's victory at Mühlberg in the succeeding April. He then followed the fortunes of his friend Maurice, the new elector of Saxony, deserted Charles, and joined the league which proposed to overthrow the emperor by an alliance with Henry II. of France. Having extorted a large sum of money from the burghers of Nuremberg, he quarrelled with his supporter, the French king, and offered his services to the emperor. Charles, anxious to secure such a famous fighter, gladly assented to Albert's demands and gave the imperial sanction to his possession of the lands taken from the bishops of Würzburg and Bamberg. After Albert had been placed under the imperial ban in Dec. 1553 on account of his depredations in Franconia, he was defeated by Henry II., duke of Brunswick, and compelled to fly to France. He there entered the service of Henry II., and had undertaken a campaign to regain his lands when he died at Pforzheim Jan. 8, 1557.

*See* J. Voigt, *Markgraf Albrecht Alcibiades von Brandenburg-Kulmbach* (Berlin, 1852).

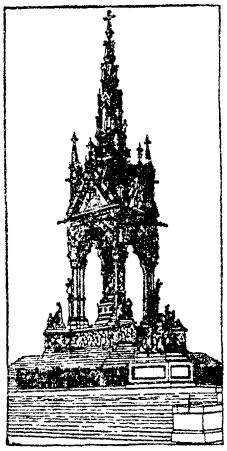
**ALBERT, PRINCE CONSORT OF ENGLAND** (1819–1861), b. at Rosenau Aug. 26, 1819. Francis Charles Augustus Albert Emmanuel was the second son of the hereditary duke of Saxe-Coburg-Gotha (belonging to the Ernestine or elder branch of the royal family of Saxony) by his first wife, the Princess Louise of Saxe-Gotha-Altenburg (d. 1831), from whom the duke was separated in 1824. His father's sister married the duke of Kent, and her daughter, afterwards Queen Victoria of England, was thus his first cousin. They were born in the same year. Albert and his elder brother, Ernest, were educated privately and at the University of Bonn. There Prince Albert studied natural science, political economy, and philosophy; he diligently cultivated music and painting, and excelled in gymnastic exercises, especially in fencing.

The idea of a marriage between him and his cousin Victoria had always been cherished by their uncle, King Leopold I. of Belgium, and in May 1836 the duke of Saxe-Coburg-Gotha and his two sons paid a visit to the duchess of Kent and her daughter at Kensington Palace. The visit was by no means to the taste of King William IV., who disapproved of the match and favoured Prince Alexander of Orange. But Leopold's plan was known to Princess Victoria, and William's objections were fruitless. Princess Victoria, writing to her uncle Leopold (May 23, 1836) said that Albert was "extremely handsome," and (June 7) thanked him for the "prospect of great happiness you have contributed to give me in the person of dear Albert. He possesses every quality that could be desired to render me perfectly happy." In the winter of 1838–39 the prince travelled in Italy, accompanied by Baron Stockmar, the Queen's confidential adviser, formerly Leopold's doctor and private secretary. On Oct. 10, 1839, he and Ernest went again to England to visit the Queen, with the object of finally settling the marriage. The betrothal took place on Oct. 15, and on Feb. 10, 1840 the marriage was celebrated at the chapel-royal, St. James's.

The public life of the Prince Consort cannot be separated from that of the Queen, and it is unnecessary here to repeat such details as are given in the article (*see* VICTORIA, ALEXANDRINA). The prejudice against him, on account of what was regarded as his undue influence in politics, was never fully dissipated till after his death. His co-operation with the Queen in dealing with the political responsibilities which devolved upon the sovereign represented an amount of conscientious and self-sacrificing labour which cannot easily be exaggerated; and his wisdom in council could only be realized, outside a very small circle, when in later years the materials for the history of that time became accessible. He was indeed a man of cultured and liberal ideas, well qualified to take the lead in many reforms which the England of that day sorely needed. He was specially interested in endeavours to secure the more perfect application of science and art to manufacturing industry.

The Great Exhibition of 1851 originated in a suggestion he made at a meeting of the Society of Arts, and owed the greater part of its success to his intelligent and unwearied efforts. He had to work for its realization against an extraordinary outburst of angry expostulations. Every stage in his project was combated. In the House of Peers, Lord Brougham denied the right of the Crown to hold the exhibition in Hyde Park; in the Commons, Colonel Sibthorp prophesied that England would be overrun with foreign rogues and revolutionists, who would subvert the morals of the people, filch their trade secrets from them, and destroy their faith and loyalty towards their religion and their sovereign.

Prince Albert was president of the exhibition commission, and every post brought him abusive letters, accusing him, as a foreigner, of being intent upon the corruption of England. He was not the man to be balked by talk of this kind, but quietly persevered, looking always to the probability that the manufacturing power of Great Britain would be quickened by bringing the best manufactured products of foreign countries under the eyes of the mechanics and artisans. The exhibition was opened by the Queen on May 1, 1851, and was a colossal success; and the realized surplus of £150,000 went to establish and endow the South Kensington Museum (afterwards renamed "Victoria and Albert") and to purchase land in that neighbourhood.



THE ALBERT MEMORIAL IN LONDON, BEGUN IN 1872 AND COMPLETED IN 1876, ERECTED IN MEMORY OF ALBERT, PRINCE CONSORT OF ENGLAND

Similar institutions, on a smaller scale but with a kindred aim, always found in him warm advocacy and substantial support. It was chiefly at meetings in connection with these that he found occasion for the delivery of addresses characterized by profound thought and comprehensiveness of view, a collection of which was published in 1857. One of his best speeches is the inaugural address which he delivered as president of the British Association for the Advancement of Science when it met at Aberdeen in 1859. The education of his family and the management of his domestic affairs furnished the Prince with another very important sphere of action, in which he employed himself with conscientious devotion.

As the Prince became better known, public mistrust began to give way. In 1847, but only after a significantly keen contest with Earl Powis, he was elected chancellor of Cambridge University; and he was soon afterwards appointed master of Trinity House. In June 1857 the formal title of Prince Consort was conferred upon him by letters patent, in order to settle certain difficulties as to precedence that had been raised at foreign courts.

But in the full career of his usefulness he was cut off. During the autumn of 1861 he was busy with the arrangements for the projected international exhibition, and it was just after returning from one of the meetings in connection with it that he was seized with his last illness. Beginning at the end of November with what appeared to be influenza, it proved to be an attack of typhoid fever, and, congestion of the lungs supervening, he died on Dec. 14. The grief of the Queen was overwhelming and the sympathy of the whole nation marked a revulsion of feeling about the Prince himself which was not devoid of compunction for earlier want of appreciation. The magnificent mausoleum at Frogmore, in which his remains were finally deposited, was erected at the expense of the Queen and the Royal Family; and many public monuments to "Albert the Good" were erected all over the country, the most notable being the Albert Hall (1867) and the Albert Memorial (1876) in London. His name was also commemorated in the Queen's institution of the Albert medal (1866) in reward for gallantry in saving life, and of the order of Victoria and Albert (1862).

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**ALBERT** (1490–1568), last grand master of the Teutonic Order, and first duke of Prussia, was born at Ansbach, May 16, 1490, the third son of Frederick of Hohenzollern, prince of Ansbach and Bayreuth, and Sophia, daughter of Casimir IV., king of Poland. In 1511 Albert was made grand master of the Teutonic Order, which had held East Prussia under Polish suzerainty since 1466. In 1519 Albert was at war with his Polish suzerain, and though a truce was made in 1521 the dispute, which was referred to the emperor, remained unsettled. Albert was then converted to Protestantism, and, supported by the advice of Martin Luther, determined to make Prussia a hereditary duchy, though he was at the same time assuring Pope Adrian VI. that he intended to reform the Order and repress Lutheranism among the knights. Eventually in 1525 a treaty was signed at Cracow by Sigismund I. of Poland, agreeing to the creation of a duchy, provided it were held as a Polish fief, and Albert was formally invested on Feb. 10.

The new duke proceeded to further Protestantism in East Prussia. He was deposed from the grand mastership, but the Teutonic knights were unable to recover Prussia, and, although he was placed under the ban of the empire, it was never enforced. In imperial politics Albert was fairly active. Joining the league of Torgau in 1526, he acted in unison with the Protestants, and was among the princes who banded themselves together to overthrow Charles V. after the issue of the *Interim* in May 1548. The early years of Albert's rule in Prussia were fairly prosperous. Although he had some trouble with the peasantry, the lands and treasures of the church enabled him to propitiate the nobles and for a time to provide for the expenses of the court. He did something for the furtherance of learning by establishing schools in every town and by giving privileges to serfs who adopted a scholastic life. In 1544, in spite of some opposition, he founded a university at Königsberg, where he appointed his friend Osiander to a professorship in 1549. But Osiander's divergence from Luther's doctrine of justification by faith involved him in a violent quarrel with Melanchthon, who had adherents in Königsberg, and these theological disputes soon created an uproar in the town. The duke strenuously supported Osiander, and the area of the quarrel soon broadened. After Osiander's death in 1552, a preacher named John Funck, with an adventurer named Paul Scalich, exercised great influence over him. The state of turmoil caused by these religious and political disputes compelled the duke to consent to a condemnation of the teaching of Osiander, and in 1566 the estates appealed to Sigismund II., king of Poland, who sent a commission to Königsberg. Scalich saved his life by flight, but Funck was executed; the question of the regency was settled; and a strict form of Lutheranism was declared binding on all teachers and preachers. The duke, a disappointed man, lived for two years longer, and died at Tapiau on March 20, 1568.

*See* J. Voigt, *Briefwechsel der berühmtesten Gelehrten des Zeitalters der Reformation mit Herzog Albrecht von Preussen* (Königsberg, 1841); K. Lohmeyer, *Herzog Albrecht von Preussen* (Danzig, 1890); E. Joachim, *Die Politik des letzten Hochmeisters in Preussen, Albrecht von Brandenburg* (Leipzig, 1892).

**ALBERT III.** (1443–1500), duke of Saxony, surnamed ANIMOSUS or THE COURAGEOUS, younger son of Frederick II., the Mild, elector and duke of Saxony, was born Jan. 27, 1443, and, after escaping from the hands of Kunz von Kaufungen, who had abducted him and his brother Ernest, passed some time at the court of the Emperor Frederick III. in Vienna. After the death of the Elector Frederick in 1464, Albert and Ernest ruled their lands together, but in 1485 a division was made by the Treaty of Leipzig, and Albert received Meissen, together with some adjoining districts, and founded the Albertine branch of the family of Wettin.

In 1475, Albert took a prominent part in the imperial campaign against Charles the Bold, duke of Burgundy, and in 1487 led an expedition against Matthias Corvinus, king of Hungary, which failed owing to lack of support on the part of the emperor. In 1488 he marched with the imperial forces to free the Roman king Maximilian from his imprisonment at Bruges, and after the king returned to Germany in 1489, Albert restored the authority of Maximilian in Holland, Flanders and Brabant. In 1498 Maximilian bestowed upon him the title of hereditary governor (potestat) of Friesland, but he had to make good his claim by force of arms. He was engaged in repressing a rising in Friesland when he died at Emden, Sept. 12, 1500. Albert, who was a man of great strength and considerable skill in feats of arms, delighted in tournaments and knightly exercises. His rule was a period of prosperity in Saxony in spite of the large sums which he spent campaigning in the emperor's service.

*See* F. A. von Langenn, *Herzog Albrecht der Beherzte, Stammvater des königlichen Hauses Sachsen* (Leipzig, 1838); O. Sperling, *Herzog Albrecht der Beherzte von Sachsen als Gubernator Frieslands* (Leipzig, 1892).

**ALBERT, DUKE OF WÜRTTEMBERG** (1865–1939), German general, the son of Duke Philip of Württemberg, was born in Vienna on Dec. 23, 1865. As the king and queen of Württemberg had no male heir, he was the heir presumptive to the Württemberg throne. He passed through the different grades of a military career and was appointed general in command of the XI. Army Corps at Cassel in 1906, and in 1908 was entrusted with the command of the Württemberg Army Corps. In 1913 he was advanced to the rank of generaloberst (colonel-general, immediately below field-marshal) and was appointed inspector-general of the VI. Army inspection. At the outbreak of World War I he took over the leadership of the IV. Army on the western front, was advanced to the rank of field-marshal-general in 1916 and appointed chief-in-command of the group of armies on the front in Alsace-Lorraine, which fought under his leadership until the end of the war. He married in 1893 the late Archduchess Margarete Sophie of Austria (d. 1902), the sister of the Archduke Francis Ferdinand, who was assassinated at Sarajevo. He died Oct. 29, 1939, at Stuttgart, Germany.

**ALBERT I.** (*c.* 1100–1170), margrave of Brandenburg, surnamed "the Bear," was the only son of Otto the Rich, count of Ballenstädt, and Eilika, daughter of Magnus Billung, duke of Saxony. He inherited the valuable Saxon estates of his father in 1123, and on his mother's death in 1142 succeeded to one-half of the lands of the Billungs. About 1123 he received from Lothair, duke of Saxony, the margraviate of Lusatia. In 1128 his brother-in-law, Henry II., margrave of the Saxon north mark, died, and Albert, disappointed at not receiving this fief, attacked Udo, the succeeding margrave, and was consequently deprived of Lusatia by Lothair. His services in Italy in 1132 were rewarded in 1134 by the investiture of the north mark, which was again without a ruler. For three years he was occupied in campaigns against the Wends, and by an arrangement made with Pribislaus, duke of Brandenburg, Albert secured this district when the duke died in 1150.

Taking the title margrave of Brandenburg, he pressed the warfare against the Wends, extended the area of his mark, did much for the spread of Christianity and civilization therein, and so became the founder of the margraviate of Brandenburg. In 1137 his cousin, Henry the Proud, had been deprived by King Conrad III. of his Saxon duchy, which was given to Albert. But he was driven from Saxony and also from his mark by Henry, and compelled to take refuge in South Germany, and when peace was made in 1142 he renounced the Saxon dukedom and received the counties of Weimar and Orlamünde.

It was possibly at this time that Albert was made arch-chamberlain of the empire, an office which afterwards gave the margraves of Brandenburg the rights of an elector. In 1162 Albert accompanied the Emperor Frederick I. to Italy, and distinguished himself at the storming of Milan. In 1164 he joined a league of princes formed against Henry the Lion, and peace being made in 1169, Albert divided his territories among his six sons. He died Nov. 13, 1170, and was buried at Ballenstädt. His personal qualities won for him the surname of "the Bear," and he is also called by later writers "the Handsome."

*See* L. von Heinemann, *Albrecht der Bär* (Darmstadt, 1864).

**ALBERT III.** (1414–86), elector of Brandenburg, surnamed ACHILLES because of his relentless energy and physical strength, and his combination of shrewdness and knight-errantry, was the third son of Frederick I. of Hohenzollern, elector of Brandenburg. Albert was born at Tangermünde on Nov. 9, 1414, and died at Frankfurt on March 11, 1486. On the division of territory which followed his father's death in 1440 he received the principality of Ansbach; on the death of his brother John in 1464 he inherited Bayreuth; and in 1470, on the abdication of his brother Frederick II., he became elector of Brandenburg. His main object was family aggrandizement, and he became as powerful among the northern as the elector of the Palatinate among the southern princes. He saw that division of inheritance weakened the family power, and he devised the famous *Dispositio Achillea* of 1473, which decreed that the mark of Brandenburg should descend intact to the eldest son, the younger son receiving the Franconian possessions of the Hohenzollerns. Both sections of the family lands were to descend thenceforward by primogeniture, a new principle in the succession of the German princely houses. He married his daughter Barbara to Henry VI. of Glogau, and after her husband's death secured a part of his Pomeranian lands for his daughter in 1482. The power of Brandenburg declined with his death. It is said that the old warrior, who had spent the greater part of his life either in fighting against the towns which desired to maintain their independence, or the princes who sought reforms, or in purely dynastic struggles, realized at the end of his life that military strength was useless so long as Germany had no sound peace, no good system of law and no general currency.

See *Das kaiserliche Buch des Markgrafen Albrecht Achilles, Vorkurfürstliche Periode, 1440–70,* ed. by C. Hoefler (Bayreuth, 1850); *Kurfürstliche Periode,* ed. by J. von Minutoli (1850); *Quellensammlung zur Geschichte des Hauses Hohenzollern,* Band I., ed. by C A. H. Burkhardt (Jena, 1857); O. Franklin, *Albrecht Achilles und die Nuremberger, 1449–53* (1866); *Politische Korrespondenz des Kurfürsten Albrecht Achilles, 1470–86,* ed. by F. Priebatsch (Leipzig, 1894–98); J. G. Droysen, *Geschichte der preussischen Politik* (1855–86).

**ALBERT** (1490–1545), elector and archbishop of Mainz, and archbishop of Magdeburg, was the younger son of John Cicero, elector of Brandenburg, and was born June 28, 1490, and died at Aschaffenburg Sept. 24, 1545. In 1513 he became archbishop of Magdeburg and administrator of the diocese of Halberstadt. In 1514 he obtained the electorate of Mainz, and in 1518 was made a cardinal.

Meanwhile to pay for the pallium of the see of Mainz and to discharge the other expenses of his elevation, Albert had borrowed a large sum of money from the Fuggers, and had obtained permission from Pope Leo X. to conduct the sale of indulgences in his diocese to obtain funds to repay this loan. For this work he procured the services of John Tetzel, and so indirectly exercised a potent influence on the course of the Reformation. When the imperial election of 1519 drew near, the elector's vote was eagerly solicited both by the partisans of Charles (afterwards the Emperor Charles V.) and of Francis I., king of France, and he appears to have received a large amount of money for the vote which he cast eventually for Charles. Albert's large and liberal ideas, his friendship with Ulrich von Hutten, and his political ambitions, appear to have raised hopes that he would be won over to the reformed faith; but after the peasants' war of 1525 he ranged himself definitely among the supporters of Catholicism. He was nevertheless compelled to grant religious liberty to the inhabitants of Magdeburg in return for 500,000 florins.

During his latter years indeed he showed more intolerance towards the Protestants. Albert adorned the *Stiftskirche* at Halle and the cathedral at Mainz in sumptuous fashion, and took as his motto the words *Domine, dilexi decorum domus tuae.* A generous patron of art and learning, he counted Erasmus among his friends.

*See* J. H. Hennes, *Albrecht von Brandenburg, Erzbischof von Mainz und Magdeburg* (Mainz, 1858); J. May, *Der Kurfürst, Kardinal, und Erzbischof Albrecht II. von Mainz und Magdeburg* (Munich, 1865–75); W. Schum, *Kardinal Albrecht von Mainz und die Erfurten Kirchenreformation* (Halle, 1878); P. Redlich, *Kardinal Albrecht von Brandenburg, und das neue Stift zu Halle* (Mainz, 1900).

**ALBERT (FRIEDRICH RUDOLF ALBRECHT),** ARCHDUKE (1817–1895), Austrian field-marshal, the eldest son of the Archduke Charles (Karl Friedrich), was born Aug. 3, 1817, in Vienna. After having been educated under the careful superintendence of his father, he entered the Austrian army as a colonel of infantry in 1837, and was transferred to the cavalry arm in 1839, and became a lieutenant-field-marshal in 1843. He learned the art of war from Radetzky. At this time the Austrian generals and staff officers had committed themselves blindly to the strategical method of the Archduke Charles, the tradition of whose practical soldiership survived only in Radetzky and a few others. Albert chose to follow Radetzky, and was thus saved from the

pseudo-scientific pedantry which brought defeat to the Austrian arms in 1859 and in 1866.

He fought under Radetzky as a volunteer throughout the campaign of 1848, having been present at the action of Pastrengo and the battles of Santa Lucia and Custozza. In the following campaign he applied for and obtained the command of a division in the 2nd corps (under d'Aspre), though his previous grade had been that of commander-in-chief. The splendid fighting of the corps at Novara was decisive, and Radetzky named d'Aspre, Count Thurn, and the archduke as the general officers worthy of the greatest rewards. In 1850 he became a general of cavalry, and in 1851 military and civil governor of Hungary, a position which he retained until 1860, when he was relieved at his own request.

Soon afterwards he was appointed to succeed Radetzky as commander-in-chief in Italy, and in 1863 he was promoted to the rank of field-marshal. When war became imminent in 1866, the archduke took command of the field army in Italy. For the story of the campaign of 1866 in Italy, *see* ITALIAN WARS. The operations of the archduke, who disposed of considerably inferior forces, were crowned with success in the brilliant victory of Custozza (June 23), and his reputation as a general-in-chief was firmly established during only eight days of field operations, though it is possible that his chief of staff, Lieutenant-Field-marshal von John, contributed not a little to the success of the Austrian arms.

The result of Custozza was the retreat and complete immobilization of the whole Italian army, so that Albert was able to dispatch the greater part of his troops to reinforce the Bohemian army, when, after having been defeated by the Prussians, it fell back on Vienna. On July 10 the archduke was summoned to Vienna to take supreme command of the forces which were being collected to defend the capital, but peace was made before further hostilities took place. From this time, under various titles, he acted as inspector-general of the army.

Like his father, and with better fortune, he was called upon to reorganize the military system of his country on an entirely new plan, learned, as before, by defeat. The principle of universal short service, and the theory of the armed nation, were necessarily the groundwork of the reforms, and the consequent preparation of all the national resources for their task in war, by the superintendence of peace administration, by the skilful conduct of manoeuvres, was thenceforward the task of his lifetime. In 1870 he conducted the military negotiations preparatory to an alliance with France, which, however, was not concluded. He retained personal control of the army until his last illness, which he contracted at the funeral of his nephew Francis, ex-king of Naples. His only remaining brother, the Archduke Wilhelm, had died a few months before, as the result of an accident. He himself died Feb. 18, 1895. His only son died in childhood, and his nephew Archduke Frederick (born 1856) inherited his great possessions, including the Albertina, a famous collection of books, manuscripts, engravings and maps, founded by Duke Albert of Saxe-Teschen.

Among the military works of the Archduke Albert, *Über die Verantwortlichkeit im Kriege* created a sensation, and was translated into English and French. He also wrote *Gedanken über dem Militärgeist; Über die höhere Leitung im Kriege;* and *Kritische Betrachtungen über den Feldzug 1866 in Italien.* He was the principal editor of the military works of his father.

*See* Mathes v. Bilabrueck, "Gedenkrede auf Weiland Sr. K. u. K. H. Erzh. Albrecht," *Mil.-Wissenschaftl. Verein* (1895); Teuber, *F. M. Erzh. Albrecht, ein Lebensbild* (Vienna, 1895); Duncker, *F. M. Erzherzog Albrecht* (Vienna and Prague, 1897).

**ALBERT,** also named ALEXANDRE MARTIN (1815–1895), the first industrial working-man to enter a government, was a member of the French Provisional Republican Government in Feb. 1848. He signed all decrees "ALBERT, *ouvrier,*" and followed implicitly the guidance of Louis Blanc (*q.v.*). He was sentenced to ten years' deportation on political grounds in 1849. On his release he secured employment as a gasworker.

**ALBERT,** MADAME (*c.* 1805–1846), French actress, whose maiden name was Thérèse Vernet, was born of a family of players. Her grace, beauty, and distinction of manner made her the idol of Paris, and her circle of admirers was widened by long tours of the provinces and abroad.

**ALBERT (OF AIX)** (fl. *c.* A.D. 1100), historian of the first crusade, was canon and *custos* of the church of Aix-la-Chapelle He wrote a *Historia Hierosolymitanae expeditionis* or *Chronicon Hierosolymitanum de bello sacro,* a work in 12 books, between 1125 and 1150. This book gives the history of the first crusade and of the Latin Kingdom of Jerusalem down to 1121. It was well known during the middle ages, and was largely used by William, archbishop of Tyre, for the first six books of his *Belli sacri historia.* The first edition of the history was published at Helmstadt in 1584, and a good edition is in the *Recueil des historiens des croisades,* tome iv. (Paris, 1841–87).

*See* M. Pigeonneau, *Le Cycle de la croisade et de la famille de Bouillon* (1877); F. Krebs, *Zur Kritik Alberts von Aachen* (Muenster, 1881); H. von Sybel, *Geschichte des ersten Kreuzzuges* (Leipzig, 1881); B. Kugler, *Albert von Aachen* (Stuttgart, 1885); F. Vercruysse, *Essai critique sur la chronique d'Albert d'Aix* (Liége, 1889).

**ALBERT, LAKE (A. NYANZA),** Uganda, situated in 1° 9′ to 2° 17′ S., and 30° 30′ to 31° 35′ E. Its greatest length is 100 mi., its greatest breadth 22 mi., and its greatest depth 55 ft. The area is approximately 1,640 sq.mi.; *i.e.,* about the size of Lancashire. The height of the lake surface above sea level is given as 2,037 ft., but this is liable to seasonal and other fluctuations.

The lake lies on the floor of the western branch of the Rift valley. Thermal springs occur at Kibiro, and again between the Murchison falls, on the Victoria Nile, and Wadelai. At Kibiro salt springs are exposed on the strand in the dry season, and give rise to a native trade in salt. At the southern end of Albert Nyanza is a wide plain, traversed by the Semliki river, which enters the lake through a swamp of tall weeds, chiefly ambach and papyrus. On both the eastern and western sides the walls of the Rift valley are close to the lake, the water in many cases washing the base of the cliffs. Elsewhere the narrow foreshore is thickly wooded. The ascent to the plateaux is generally by a series of abrupt steps. On the western side the mountains present many pointed and conical summits, some of which may be nearly 8,000 ft. above the lake; on the eastern side the cliffs rise sharply for 1,000 to 2,000 ft. On either coast wild ravines, densely wooded, break the outline of the mountains. Through these gorges and over the plateau-edge fall magnificent cascades. Towards the north the hills recede from the coast and on both sides flats extend for distances varying from ·5 mi. to 15 mi. On the eastern side, 92 mi. from the southern end of the Nyanza, the Victoria Nile enters the lake, here not more than 6 mi. across, through a wilderness of woods, the delta of the Nile extending over 4 mi. The mouth of the main stream is obstructed by a bar of its own formation; the current is sluggish; there are many side channels, and the appearance of the lake gives no hint that a great river has joined its waters. For 5 mi. or 6 mi. north of the junction of the Victoria Nile the lake suffers no material diminution in width. Then, however, the eastern and western shores approach each other, and a current is perceptible flowing north. The lake has become the Bahr-el-Jebel, or Mountain river, as this section of the Nile is called. Albert Nyanza is shallow; at its southern end the water for a considerable distance is not more than 3 ft. deep. The deepest soundings give only 50 ft. to 55 ft., the average depth being 30 to 40 ft.

**The Albertine Basin of the Nile.**—Albert Nyanza receives the whole of the drainage of Edward Nyanza and the Semliki river, and with them forms the "Albertine" Nile system. Its waters, as stated above, mingle with those of the Victoria Nile. There is evidence of very considerable shrinkage in the size of these lakes. Within human times the level of Albert Nyanza appears to have been 1,000 ft. higher than it is at present. The causes of this fall have not been fully explained. Both tectonic and climatic agencies may be involved. River erosion is probably also a complicating factor. In recent geological times the valley to the north of Edward Nyanza, then much larger than now, was blocked. The removal of the block led to the shrinkage of the lake and the formation of the Semliki, which found its way to the more northern lake—Albert Nyanza. Gradually the Semliki eroded its bed, and consequently the level of Edward Nyanza

continued to fall. The process continues but is checked by the existence of the rock barrier which stretches across the Semliki. This stream leaves Edward Nyanza at its northwest end in 0° 8′ 30″ S., and after a course of about 160 mi. enters Albert Nyanza in 1° 9′ N. In its upper and in its lower course the river flows either through high alluvial plains, in which it has scored a deep channel, or across swamp land. In the middle section, which has a length of some 75 mi., the river runs in a deep narrow valley covered with the densest forest. On the west this valley is bounded by the Congo mountains, which form the wall of the Rift valley, on the east by the mighty range of Ruwenzori, whose heights tower over 16,000 ft. above sea level. In this length of 75 mi. the river falls in cataracts and rapids over 800 ft.

Albert Nyanza, on the other hand, is threatened in the distant future with destruction from another cause—the filling of its bed by the alluvium poured into it by the Semliki, the Victoria Nile and other streams. The Semliki receives directly or indirectly the whole of the drainage of Ruwenzori, and also that of the eastern face of the Congo mountains as well as the drainage basin of Edward Nyanza. The Semliki, as it emerges from the region of forest and cataracts and deposits much of its burden, becomes sluggish as its slope flattens out. This process has formed a large plain at the south end of Albert Nyanza, which has seriously encroached upon the lake. At the northern end of the lake the sediment brought down by the Victoria Nile is producing a similar effect. Nyamsasi, which was an island at the southwest end in 1889, has become a peninsula. Islands which in 1876 were on the east coast no longer exist; they now form part of the foreshore. On the other hand, the shrinkage of the lake level caused the appearance in 1885 of an island where in 1879 there had been an expanse of shallow water. It seems probable that, in a period geologically not very remote, the "Albertine" system will consist of one great river, extending from the northern slopes of the Kivu range, where the Ruchuru has its rise, to the existing junction of the Victoria Nile with Albert Nyanza.

The combined drainage area, including the water surface of Edward Nyanza, the Semliki and Albert Nyanza, is some 16,600 sq.mi. Throughout this area the rainfall is heavy (40 in. to 60 in. or more per annum), the volume of the Semliki in flood being not less than 700 cu.mi. per second. Of the water received by Albert Nyanza annually (omitting the Victoria Nile from the calculation) between 50% and 60% is lost by evaporation, while 24,265,000,000 cu.mi. are annually withdrawn by the Bahr-el-Jebel. The "Albertine" system plays a comparatively insignificant part in the annual flood rise of the White Nile, but to its waters are due the maintenance of a constant supply to this river throughout the year.

**Discovery and Exploration.**—Albert Nyanza was first reached by Samuel Baker on March 14, 1864, near Vacovia, a small village of fishermen and salt-makers on the east coast. Albert Nyanza was entered on his map as a vast lake extending about 380 mi. But the circumnavigation of the lake by Gessi Pasha (1876) and by Emin Pasha in 1884 showed that Baker had been deceived as to the size of the lake. The lake forms part of the (British) Uganda Protectorate, but the northwest shores were leased in 1894 to the Congo Free State. Of this leased area a strip 15 mi. wide, giving the Congo state a passageway to the lake, was to remain in its possession after the determination of the lease. (*See* also NILE.)

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**ALBERTA,** province of Canada, created 1905. Area 255,285 sq.mi. (land 248,800, water 6,485). The population in 1951 was 939,501.

**Geography and Geology.**—Alberta has a natural geographical boundary only on its western side, the watershed of the Rocky mountains. On the north the parallel of 60° N. separates it from the Northwest Territories, on the east the meridian of 110° W. from Saskatchewan and on the south the parallel of 49° N. from the United States. Geographically it is thus divided as between the wooded mountain slope from the hills, and the drainage basins of three river systems below. A small southern part of the province is drained by the Milk river, a tributary of the Missouri. Of the rest of the province the lower half, mainly prairie land, the more thickly settled portion, is drained by the waters and branches of the South and North Saskatchewan. The northern, less settled portion, a more rolling country of woods and grassland, is drained by the Athabasca and the Peace.

Geologically the greater part of Alberta belongs to the interior continental plain showing in the southwest a general elevation of about 3,500 ft. and in the extreme northeast at the Great Slave river only 600 ft. The mountainside strip of the eastern slope of the Rockies is a part of the Cordilleran belt; the summits of the Rockies bordering Alberta show an altitude of 8,000 to 9,000 ft. with many peaks over 10,000, while the passes used by the railways show 4,450 ft. for the Crowsnest Pass station, 5,332 for Kicking Horse (C.P.R. main line) and 3,711 for Yellowhead Pass station (C.N.R.).

**Climate.**—Sir Frederic Stupart, director of the Meteorological Service of Canada (1894–1929) said that "it is doubtful whether any other territory on the face of the globe has a climate as variable in the winter as that of Alberta." The normal winter is cold, extreme cold persisting in some years from November to March, inclusive, but in others the Chinook winds, the warm winds from the west carried over the Rockies, dominate the winter. April shows an average temperature of 53° at Calgary, 53° at Edmonton, 58° at Medicine Hat. The average July–August temperatures are 75° at Calgary, 74° at Edmonton, 82° at Medicine Hat, with a usual summer limit of 90° and records of over 100°. The isothermal lines run from the Rockies to the United States border in a southeastern direction. The January mean temperature of 0° passes a little north of Edmonton and crosses lower Saskatchewan to North Dakota. The line of −15° slants across northern Alberta passing Fort Vermilion on the Peace river and circling the lower Hudson bay to Ungava. The four winter months, December to March, show averages: Calgary 18°, Edmonton 14°, Dunvegan 6° and Chipewyan −3°. The summer isotherms are complicated and diverge greatly from an east to west direction to form loops. Most of the province shows July isotherms of 60° to 65°. The Peace river country round Dunvegan and the Lake Athabasca district have much the same summer heat as Calgary with longer sunlight, favouring growth. The average rainfall till the end of July is nearly equal to that of Ontario except in the drier southern belt. A change of wind from a northeast blow to a southwestern Chinook at times changes the temperature from 20° below to 40° above zero in a few hours.

**History.**—Alberta was originally a part of the Hudson's Bay territory granted by the charter of 1670. It remained long unknown. Following the lead given by Pierre de la Vérendrye, Pierre Boucher, sieur de Boucherville, made his way across the plains and set a temporary stockade, Fort Jonquière, at the foot of the Rockies in 1751. But even in 1774 the Hudson's Bay company had no post west of Cumberland House, established that year on the lower Saskatchewan. The North West company, formed in 1783, disregarding the Hudson's Bay company charter, first penetrated that empty region. Under their auspices Alexander Mackenzie in 1789 descended the Athabasca and the Mackenzie to the sea and in 1792–93 ascended the Peace river and crossed the Rockies to the Pacific. Mackenzie founded Fort Chipewyan (Lake Athabasca) in 1789. Both companies founded posts near Edmonton (1795) but the fur trade developed northward.

The transfer of the northwest in 1869 from the Hudson's Bay company to the new dominion led to surveys for railroads (Sir Sandford Fleming, 1871) and to the Homestead act for settlement (1875), the establishment of the Northwest mounted police (1873) and, on completion of the Canadian Pacific railway (1885), to a continued influx of settlement from older Canada, from overseas and across the border which assumed the proportions of an invasion after 1900. Migration from continental Europe was a special feature. Settlement led to territorial government at first under the Northwest Territories act of 1875. An act of 1882 separated out four provincial "districts" (Assiniboia, Saskatchewan, Alberta, Athabasca) leaving west of Hudson bay the area north of 60° as Northwest Territories (*see* NORTHWEST TERRITORIES). Later in the same year Regina was established as the seat of government. There first appeared on the map the name Alberta (lower half of the present) as a tribute to Queen Victoria, recalling the memory of the prince consort through his daughter Princess Louise Alberta. At the census of 1901 Alberta and Athabasca (the area now Alberta) had a population of 73,022; Calgary, of 4,392; and Edmonton, of 4,176. The ensuing rapid settlement led in 1905 to the creation of the present province of Alberta, beside the sister province of Saskatchewan. The provinces had at once the status conferred by the British North America Act of 1867 but, to facilitate settlement, the public domain remained under federal control until 1929, when it was transferred to the provinces. Good times brought rapid growth, with the organization of education (University of Alberta at Edmonton, 1907), the professions and cultural life but with grain farming as the economic basis. The population reached 374,295 in 1911 and 588,454 in 1921. The service of Alberta in World War I belongs in general Canadian history.

The ministerial government of the new province was at first oper-

ated by parties formed on the standing model of conservatives and liberals. But the special agrarian interests of the province led to the creation of a United Farmers' association, which presently entered the political sphere and gained control of the government in 1921. The United Farmers' policy was chiefly connected with co-operative marketing of grain which gained great ascendancy and prestige by the temporary success of provincial "pools" united by a central marketing board for the prairie provinces. Depression and the collapse of prices proved too great a burden for the pools, which gave place to government regulations of wheat prices. The result led to the defeat of the farmers' parties by the Social Credit party, led by William Aberhart, which gained office in 1935 and undertook to pass legislation for forced conversion of the public debt, or cancellation, whole or partial, of existing land mortgages, the issue of provincial paper money in the form of legal tender certificates and the restriction of the press. All these measures underwent judicial revision and abrogation by both local and federal disallowance, and by the decisions of the supreme court of Canada and then of the privy council. For details of this complicated record *see* the special *Rowell-Sirois Report of 1940* and the *Case for Alberta* as presented by the province under that name to the above commission.

**Resources.**—The natural resources of Alberta are on a colossal scale. Of its total land area of 248,800 sq.mi., 136,640 was classed (1946) as agricultural land present or potential, of which 48,295 was forested land fit to be cleared for agriculture. Of a total of 130,620 sq.mi. of forest land, 37,560 is nonproductive land, but it serves to shelter game and conserve rainfall. The geological survey of Canada estimates the coal area of the province at 16,588 sq.mi. containing a possible reserve of 47,874,300,000 tons. Petroleum from the subterranean oil pools of the Turner valley, Leduc, Redwater, Woodbend and other foothill areas constitutes 97% of the Canadian output. Geological investigation points to the existence of similar pools in the Peace River district. Natural gas is found abundantly in different localities while the tar sands of the Athabasca offer a major potential source of oil not yet put to commercial use. In point of water power Alberta at mid-20th century showed available 24-hr. horsepower (at ordinary six months' flow) of 1,258,000; actual turbine installation (Dec. 1949) was 107,225 h.p. This compares with a Canadian total available of 42,899,000 h.p. and installed 11,613,333 h.p. The fisheries of Alberta include whitefish, pickerel, trout, etc., from its lakes and rivers.

**Population.**—The population of Alberta, census of 1951, was 939,501; Calgary, 129,060; Edmonton, 159,639. In national and cultural origin because of migration as described above it is more varied than the people of any other Canadian province. The Canadian census classification did not show Americans (of the U.S.) as a racial class but distributed them by origin. Taken thus (1941 census) the population of Alberta was 53% British, 10% German, 7.5% Ukrainian, 5% French, 3.6% Norwegian, 2.8% Polish, 1.7% Dutch, 1.6% Italian and the rest various with 2% native Indian.

**Finance.**—The province of Alberta had at its inception a public revenue of $1,425,059, which had grown by 1947 to $54,626,000. The gross public bonded debt, nil in 1905, reached $29,000,200 in 1916 and $139,350,000 by 1947. The chief sources of revenue are federal subsidies, gasoline taxes, succession duties, corporation taxes and revenue from liquor control and petroleum leases.

**Agriculture.**—In the economy of Alberta agriculture naturally fills the largest place. Its relative place may be gauged from the following data, collected in 1948: total gross value of production in Canada $18,143,186,852; in Alberta $1,073,361,412 (compare Ontario leading with $7,672,980,044); total net value of agriculture production in Canada $1,994,391,000; in Alberta $388,420,000 (compare Ontario leading with $496,334,000). In 1948 agriculture accounted for 58% of the net output of the province as compared with 16% for manufactures, 12% for mining and 9% for construction.

Agriculture in Alberta was greatly aided by irrigation of the drier areas. Surface waters were vested in the crown and the Irrigation Districts acts of Alberta provided for forming districts, initiating projects and raising loans by local votes. The chief sources of water are the Bow, the St. Mary, the Milk and the Oldman rivers. The total irrigable area of the 15 major projects as reported in 1948 was 719,035 ac. and in addition there were about 700 private irrigation systems covering 70,000 irrigable acres.

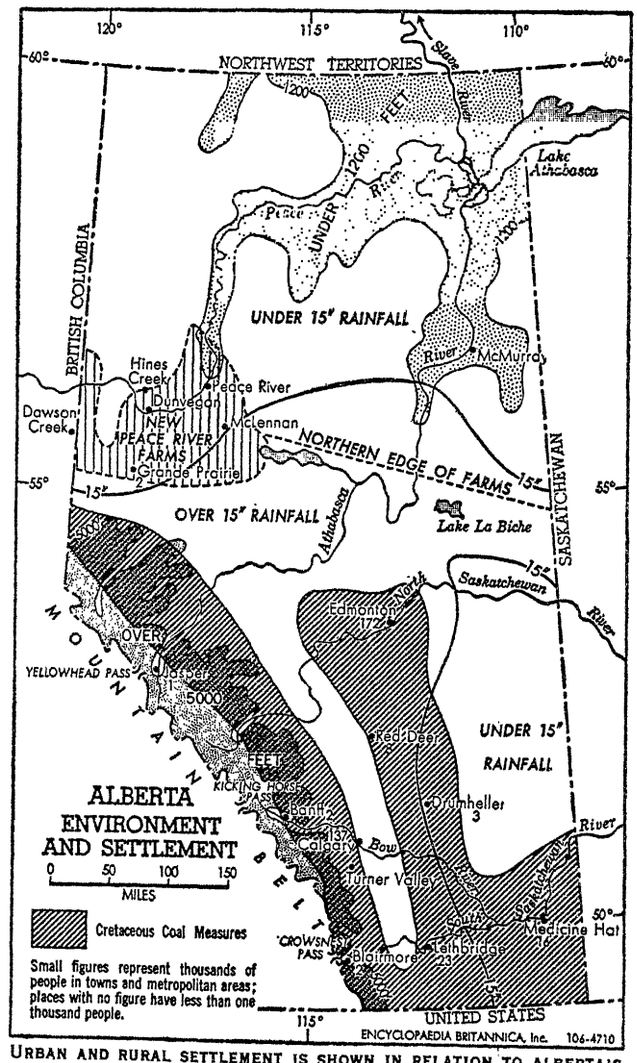
**Crops.**—In Alberta the 1949 area planted in spring wheat was 7,586,000 ac. (average, 1943–47, 6,402,000 ac.), as compared with oats, 2,255,000 ac. (average, 1943–47, 3,098,000 ac.), and barley, 2,118,000 ac. (average, 1943–47, 2,073,000 ac.). Rye (planted both spring and fall) is a lesser crop—in 1949, 325,000 ac. (average, 1943–47, 181,000 ac.). Sugar beets expanded from 14,000 ac. in 1935 to 32,000 in 1949. Statistics show for Alberta, for 1949, field crops $338,778,000 (compare 1940, $136,572,000); farm animals $205,733,000 (1948) (compare 1940, $47,801,000); milk $43,102,000; poultry and eggs $22,845,000; fur farming $3,761,727; clover and grass seed $10,241,000.

**Environment and Settlement.**—In order to understand the possibilities of settlement in Alberta, the general environment must be studied closely; the necessary data are charted in the accompanying map. The mountain belt of Alberta (more than 5,000 ft.) is confined to the extreme southwestern margin along the Rocky Mountain uplift. There are many complicated formations, mainly of Cambrian age. But on the eastern edge the much younger Cretaceous formations are also involved in the folding. Consequently there are valuable coal seams, especially in the vicinity of Kicking Horse pass and Crowsnest pass, right in the mountain area.

Throughout the south of Alberta the formations are fairly level-bedded, and are almost all of Cretaceous age. Coal seams are found at three levels in these Cretaceous rocks; and for a time they were thought to contain almost the largest resources of coal in the world. Later estimates gave them about 47,874,300,000 tons, about equal to the resources of the Bohemian or Donetz coal fields in eastern Europe. Red Deer, Drumheller and Lethbridge contain the chiel coal mines worked in these fairly level coal seams. (The coal measures are indicated in the map.) Just below the lowest coal seams a layer of porous rocks at Turner Valley contains petroleum, about 3,000 ft. below the surface. In 1947 a new major field was discovered at Leduc, 18 mi. S. of Edmonton, and there are other fields of almost equal importance in production in other parts of Alberta.

Despite these important petroleum resources, it is because of agriculture that Alberta shows greatest promise. The rainfall conditions are satisfactory in most of the province, excluding the southeast corner. The rain lines for 15 in. are shown in the map and form a sort of wet belt across the province about the latitude of Edmonton. The rain falls off to 11 in. in the extreme northeast, and also near Medicine Hat. The cooler climate of the north of the province gives the rainfall more value than in the far southeast, where ranching replaces farming to some extent. The main areas occupied in the Peace River settlements are shown, and by 1941 there were almost 50,000 settlers there. In 1911 there had only been 1,100 people in the district. Grand Prairie, Peace River and McLennan are three of the small towns. To the northeast of Edmonton the notable population extends only to Lake La Biche; the edge of settlement is shown on the map.

Thus, of the 940,000 people living in Alberta, almost the whole number lie south of the line joining Lake La Biche to Dunvegan, while in the rather arid portion north of Medicine Hat the population is




URBAN AND RURAL SETTLEMENT IS SHOWN IN RELATION TO ALBERTA'S CLIMATIC AND PHYSIOGRAPHIC ENVIRONMENT AND TO THE PRINCIPAL NATURAL RESOURCE OF THE PROVINCE—COAL

also very sparse. If reference is made to the temperature maps of Canada, it will be found that the July isotherm of 57° F.—which determines the climatic limits of crops—runs far to the north of any part of Alberta. Hence, it may be expected that a hay-potato-oats type of farming would in the distant future expand over a good deal of the empty country of north Alberta. However, since Alberta has much greater coal resources than the other provinces, and since the oil resources invite subsidiary chemical plants, it seems likely that there might also be increasing development of industrial settlement.

**Government Aid.**—Extensive and detailed assistance to the farming community is given by the provincial department of agriculture through field crop, livestock, dairy, poultry, veterinary services, agriculture branches. Expert agriculturists located in 43 different districts conduct short courses, field days and lecture demonstrations. Publications on agriculture and home economics are distributed free. Students attend each year the schools of agriculture at Olds and Vermilion, each school having a demonstration. A provincial horticultural station is maintained at Brooks.

**Manufactures.**—As in all the prairie provinces manufactures in Alberta occupy a secondary place and are confined to secondary forms of manufacture rather than the heavy industries. Of particular importance are the 69 flour mills of the province, and the meat-packing plants of Edmonton. Other manufactures in Edmonton are those of furniture, general lumber, biscuits and clothing, and oil refining. The manufactures of Calgary include meat packing, woodworking, oil refining and a nitrogen plant. The total (1947) value of manufactures in the province was (gross) $296,054,129. At the latest complete classification (1947) Calgary was reported as having 246 establishments with 7,790 employees; Edmonton 222 with 7,625; Medicine Hat 27 with 1,049; and Lethbridge 37 with 893.

**Transport and Communications.**—The southern half of Alberta is well supplied with railways now extending northward to connect with steam navigation down the Mackenzie river system. The total mileage in 1949 apart from second tracks and sidings was 5,643. The Canadian Pacific railway, the first road constructed across the province, created the town of Calgary as a proper junction point for a line on the North Saskatchewan at Fort Edmonton. The Grand Trunk Pacific (later Canadian National), initiated in 1903 and completed in 1915, was built across the more fertile valley of the South Saskatchewan to pass through the Yellowhead pass and so to Vancouver by the valley of the Fraser with a northern branch to reach the Pacific 500 mi. farther north at the mouth of the Skeena river (Prince Rupert) There is a third railway route, the most southerly and the shortest, through the Rockies via the Crowsnest pass by the Canadian Pacific railway. From both of the present railway systems branch lines reach various points in the southern province. Northern connections from Edmonton are made by the Canadian Pacific to the Athabasca river waterways (Fort McMurray) and across the Peace River valley (C.P.R.) to Hines Creek and to Dawson Creek (B.C.), just beyond the provincial boundary. This point became the railhead for the Alaska highway, military and international, connecting with rail at Fairbanks, Alaska. The Banff-Jasper highway, completed in 1940, connects Banff, Lake Louise and Jasper.

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**ALBERT EDWARD NYANZA:** *see* EDWARD, LAKE.

**ALBERTI, DOMENICO** (*c.* 1710–1740), Italian musician, achieved unawares something like immortality in musical history as the writer of dozens of sonatas in which the melody is supported from beginning to end by an extremely familiar, but nowadays little-esteemed, formula of arpeggio accompaniment, consequently known as the Alberti bass.

**ALBERTI, LEONE BATTISTA** (1404–1472), Italian painter, poet, philosopher, musician and architect, was born in Venice on Feb. 18, 1404. He was so skilled in Latin verse that a comedy he wrote in his 20th year, entitled *Philodoxius,* deceived the younger Aldus, who edited and published it as the genuine work of Lepidus. In music he was reputed one of the first organists of the age. At Rome he was employed by Pope Nicholas V in the restoration of the papal palace, and of the foundation of Acqua Vergine, and in the ornamentation of the magnificent fountain of Trevi. At Mantua he designed the church of Sant' Andrea, at Rimini the church of San Francesco, which is generally esteemed his finest work, and in Florence the principal façade of the church of Santa Maria Novella, as well as the family palace now known as the Palazzo Strozzi. His most celebrated treatise is that on architecture, *De Re Aedificatoria,* which was translated into Italian, French, Spanish and English.

*See* Passerini, *Gli Alberti di Firenze* (1869–70); Mancini, *Vita di Alberti* (Firenze, 1882); V. Hoffmann, *Studien zu Leon Battista Alberti's zehn Büchern: De Re Aedificatoria* (Frankenberg, 1883).

**ALBERTINELLI, MARIOTTO** (1474–1515), Italian painter, was born in Florence, and was a fellow pupil and partner of Fra Bartolommeo, with whom he painted many works. His chief paintings are in Florence, notably his masterpiece, the "Visitation of the Virgin" (1503) at the Uffizi.

**ALBERTITE,** a pyrobitumen (*see* BITUMEN) so named from the type occurrence in Albert county, New Brunswick. It is jet black in colour, has a brilliant lustre and a conchoidal to hackly fracture. It occurs typically in veins up to many feet in thickness and is a derivative of petroleum. (J. R.)

**ALBERT LEA,** a city of Minnesota, U.S.; the county seat of Freeborn county; the population, predominantly Scandinavian, was 13,488 in 1950 and 12,200 in 1940 by the federal census. It is on federal highways 65, 69 and 16, and is served by the Rock Island, the Chicago, Milwaukee, St. Paul and Pacific, the Illinois Central and the Minneapolis and St. Louis railways. The city is between Lake Albert Lea and Fountain lake in the south central part of Minnesota.

Diversified manufactures include food and beverage products, building equipment, tools and machinery, castings, wood products, fertilizer, concrete products, paint, plastic, clothing, athletic equipment, prefabricated buildings, shaving cream and numerous others.

The city takes its name from Col. Albert Miller Lea (1808–91), a West Point graduate (1831) who visited the area in 1835 as topographer with the U.S. dragoons. Colonel Lea wrote extensively of the area and is credited with naming the state of Iowa. A post office was established at Albert Lea in 1855, and the city received its charter in 1878. The city has a council-manager form of government.

**ALBERT MEDAL,** a British decoration instituted in 1866 as an award for signal acts of bravery in saving life at sea, and extended in 1877 to acts of bravery on land. The conditions governing the award were amended in 1905. There are two classes, each with two divisions. The medal, which is in gold for the 1st class and bronze for the 2nd, is oval, and bears the monogram V.A. The ribbon is either blue (for bravery at sea) or crimson (for bravery ashore) with white vertical stripes.

**ALBERTUS MAGNUS,** ALBERT OF COLOGNE (1206?–1280), scholastic philosopher called *doctor universalis.* Albert was born of the family of the counts of Bollstädt, at Lauingen, in Suabia. In 1223 he joined the Dominican order, and after teaching in turn at Cologne, Hildesheim, Freiburg, Ratisbon, Strasbourg and again at Cologne, was sent to Paris from 1245 to 1248, and there acquired great fame. (Roger Bacon, who was by no means friendly toward Albert, speaks of him as "the most noted of Christian scholars.") When he returned to Cologne in 1248 to organize the *studium generale,* Thomas Aquinas, who had been under his direction at Paris, went with him. From 1254 to 1257 he was provincial of the German province, during which time he defended the Mendicants against the University of Paris and its spokesman, William of St. Amour. From 1260 to 1262 he held the bishopric of Ratisbon. From that date to 1270, when he returned to Cologne as a *lector,* he seems to have been travelling about preaching a crusade in Germany and Bohemia, and undertaking various other ecclesiastical missions in Würzburg and Strasbourg. In 1277 he returned to Paris to defend the doctrines of Aquinas against the condemnations of Bishop Tempier. Albert's works, which were mostly completed before 1256, were published in 21 folio vol. by Jammy at Lyons in 1651, and reprinted in 36 vol. by Borguet (Paris, 1890). They include paraphrases of all of Aristotle's works, a commentary on the *Sentences* of Peter Lombard, an incomplete *Summa Theologiae,* a treatise against Averroes and the curious *De Causis et Processu Universitatis*—a work of Neoplatonic colouring.

Albert has a remarkable affinity with the early Franciscan philosophers of Oxford; thus, his love of experimental science, and his knowledge of geography, astronomy, medicine, zoology and botany, are strongly reminiscent of Robert Grosseteste and Bacon, while his interweaving of Aristotelian, Arabian, Jewish, Neoplatonic and Augustinian elements bears a close resemblance to the system of Thomas of York. However, as far as his Dominican successors are concerned, Albert's chief influence seems to lie in his successful propagation of an esteem for Aristotle. Hence, his project of "adapting Aristotle to the use of the Latin races" was fulfilled in spite of the intense distrust of Aristotle that had been

aroused by the Paris condemnations of his works on natural science and metaphysics in 1210, 1215, 1231 and 1245.

*See* J. Sighart, *Albertus Magnus, sein Leben und seine Wissenschaft* (1876); Paget Toynbee, "Some Obligations of Dante to Albertus Magnus" in *Romania* (1895); E. Michael, *Geschichte d. deutschen Volkes vom 13 Jahrh.* (1903) v. iii. p. 445 *seq.* (for Albert's scientific interests); A. Schneider, *Die Psychologie Alberts d. Gr.* (1906); C. Baeumker, *Witelo* (1908) (for Albert's Neoplatonism); H. Lauer, *Die Moraltheologie Alberts d. Gr.* (1911); P. Mandonnet, *Siger de Brabant* (1911); L. Gaul, *Alberts des Grossen Verhältnis zu Plato* (1913); G. von Hertling, *Albertus Magnus, Beiträge zu seiner Würdigung* (1914).

**ALBERUS, ERASMUS** (*c.* 1500–1553), German humanist and poet, was born at Sprendlingen, near Frankfort, and died at Neubrandenburg on May 5, 1553. He was almost the only member of Luther's party who commanded an effective weapon of satire. He ridiculed the Franciscan order in his *Barfüsser Mönche Eulenspiegel und Alkoran* (1542, preface by Luther), and gave his views on church and state in a collection of fables entitled *Buch von der Tugend und Weisheit* (1550). Some of his hymns are used in the Lutheran hymnal.

BIBLIOGRAPHY.—*Das Buch von der Tugend und Weisheit* has been edited by W. Braune (1892); the 16 *Geistliche Lieder* by C. W. Stromberger (1857). Alberus's prose writings have not been reprinted in recent times. *See* F. Schnorr von Carolsfeld, *Erasmus Alberus* (1894).

**ALBI,** a city of south-west France, in the department of Tarn, 48m. N.E. of Toulouse, on a branch line of the Southern railway. Pop. (1946) 34,342. It occupies a commanding position on the left bank of the Tarn, where its valley broadens as it emerges from the high *Plateau Central* toward the plain of Toulouse; a bridge crosses to La Madeleine (a suburb).

Albi (*Albiga*) was capital of the Gallo-Roman Albigenses, and later of the viscounty of Albigeois, a fief of the counts of Toulouse. From the 12th century onward its bishops encroached on the authority of the viscounts and, after the Albigensian War, lost their estates, which passed ultimately to the Crown. By a convention (1264), the chief temporal power was granted to the bishops. A nucleus of narrow, winding streets is surrounded by boulevards, beyond which lie modern quarters. The cathedral of Sainte Cécile, a fine Gothic fortress-church built in 1277–1512, is without transepts or aisles; the rood-screen and the choir-enclosures (about 1500) are masterpieces. The 14th-century archbishop's palace to the northeast is fortified.

The church of St. Salvi belongs to the 13th and 15th centuries. There are dye-works, cement-works, coal-mines, glass-works and important flour-mills. Hats, cloth fabrics, umbrellas, artificial silk and agricultural implements are also made. Trade is in wheat, wine, and prunes. Albi is the seat of an archbishop (1678), a prefect, and a court of assizes. It has tribunals of first instance and of commerce, a board of trade arbitrators and a chamber of commerce.

**ALBIA,** a city of Iowa, U.S., 68 mi. S.E. of Des Moines, in a fertile farming and stock-raising district and in the Albia coal field; the county seat of Monroe county. It is a junction point of the Burlington, the Wabash, and the Minneapolis and St. Louis railways, and is the northern terminus of the Iowa Southern Utilities company. It has several industrial plants, and is an important distributing centre for the coal and agricultural products of the region. The population in 1950 was 4,823; in 1940, 5,157.

**ALBIGENSES,** the usual designation of the heretics—and more especially the Catharist heretics—of the south of France in the 12th and 13th centuries. This name appears to have been given to them at the end of the 12th century, but the designation is hardly exact, for the centre of the movement was at Toulouse and in the neighbouring districts rather than at Albi (the ancient *Albiga*). The heresy, which had penetrated into these regions probably by trade routes, came originally from eastern Europe. The name of Bulgarians (*Bougres*) was often applied to the Albigenses, and they always kept up intercourse with the Bogomil sectaries of Thrace. Their dualist doctrines, as described by controversialists, present numerous resemblances to those of the Bogomils (*q.v.*), and still more to those of the Paulicians, with whom they are sometimes connected. It is exceedingly difficult, however, to form any very precise idea of the Albigensian doctrines, as our knowledge of them is derived from their opponents, and the very rare texts which have come down to us, emanating from the Albigenses (*e.g.*, the *Rituel cathare de Lyon,* ed. by Cunitz, Jena, 1852, and the *Nouveau Testament en provençal,* ed. by Clédat, Paris, 1887), contain very inadequate information concerning their metaphysical principles and moral practice. What is certain is that, above all, they formed an anti-sacerdotal party in permanent opposition to the Roman Church, and raised a continued protest against the corruption of the clergy of their time. The Albigensian theologians and ascetics, the Cathari or *perfecti,* known in the south of France as *bons hommes* or *bons chrétiens,* were few in number; the mass of believers (*credentes*) were perhaps not initiated into the Catharist doctrine; at all events they were free from all moral prohibition and all religious obligation, on condition that they promised by an act called *convenenza* to become "hereticized" by receiving the *consolamentum,* the baptism of the Spirit, before their death or even *in extremis.*

The first Catharist heretics appeared in Limousin between 1012 and 1020. Protected by William IX., duke of Aquitaine, and soon by a great part of the southern nobility, the movement gained ground in the south, and in 1119 the Council of Toulouse in vain ordered the secular powers to assist the ecclesiastical authority in quelling the heresy. The people were attached to the *bons hommes,* whose asceticism and anti-sacerdotal preaching impressed the masses, and the movement maintained vigorous activity for another hundred years, until Innocent III. ascended the papal throne. At first he tried pacific conversion; but his envoys had to contend not only with the heretics, the nobles who protected them and the people who listened to them and venerated them, but also with the bishops of the district, who rejected the extraordinary authority which the pope had conferred upon his legates. At last (1209) the pope ordered the Cistercians to preach the crusade against the Albigenses. This implacable war, which threw the whole of the nobility of the north of France against that of the south, and destroyed the brilliant Provençal civilization, ended, politically, in the Treaty of Paris (1229), which destroyed the independence of the princes of the south, but did not extinguish the heresy, in spite of the wholesale massacres of heretics during the war. The Inquisition, however, operating unremittingly in the south at Toulouse, Albi and other towns during the whole of the 13th century and a great part of the 14th, succeeded in crushing it. There were indeed some outbursts of rebellion, some fomented by the nobles of Languedoc (1240–42) and others emanating from the people of the towns, who were embittered by confiscations and religious persecutions, but the repressive measures were terrible. In 1245, the royal officers assisting the Inquisition seized the heretical citadel of Montségur, and 200 Cathari were burned in one day. Moreover, the Church decreed severe chastisement against all laymen suspected of sympathy with the heretics (Council of Narbonne, 1235; Bull *Ad extirpanda,* 1252).

Hunted down by the Inquisition and now abandoned by the nobles of the district, the Albigenses became more and more scattered, hiding in the forests and mountains, and only meeting surreptitiously.

The sect, moreover, was exhausted and could find no more adepts in a district which, by fair means or foul, had arrived at a state of peace and political and religious unity.

BIBLIOGRAPHY.—*See* C. Schmidt's *Histoire de la secte des Cathares ou Albigeois* (1849), which is still the most important work on the subject. On the ethics of the Catharists, *see* Jean Guiraud, *Questions d'histoire et d'archéologie chrétienne* (1906); and P. Alphandéry, *Les idées morales chez les hétérodoxes latins au début du XIIIe siècle* (1903). *See* also under CATHARS.

**ALBINO,** a biological term (Lat. *albus,* white) for a pigmentless individual of a pigmented race. Pigmentation depends upon the presence and interaction in the tissues of colour-bases, chromogens, colourless in themselves, and ferments or enzymes which, acting upon the colour-bases, yield coloured products. If, therefore, either of these ingredients of pigmentation is absent from the constitution of an individual, it must perforce remain pigmentless, albinotic, even though in the environment in which it

lives there are agents, such as sunlight, which are known to stimulate the production of pigment in the tissues of animals and plants exposed to their action. An albino is an individual whose tissues lack the power to elaborate either the ferments or the colour-bases.

In man the general colour of the skin ranges from the fair, almost pigmentless, condition of the Scandinavian to the almost ebony blackness of the natives of certain parts of Africa. These differences have been employed in the classification of races into white, yellow, red, brown, and black. The colour of the skin proper is creamy white. To this is added a tinge of yellow due to the presence of a yellow pigment in the skin. A further ingredient is black, due to the presence of minute granules of melanin, itself sepia in colour but, in masses, so completely absorbing the light that it appears black. Lastly, the red colour of the blood circulating in the minute vessels of the skin adds its tint. It is possible, by using a spinning top with a combination of these colours, white, yellow, red, and black in different proportions, to match any particular skin colour, and it is found, when this is done, that in all pigmented skins all these four colours can be identified, and that different proportions of the yellow and the black in combination correspond to different racial skin colorations. The relative proportions of these two pigments vary greatly in different individuals and in different regions of the body of one and the same individual.

Albinism is the condition, as estimated by this test, in which the black pigment is absent and in which the yellow is present only in relatively small amount.

The eyes of the albino are pink, this colour being the red of the blood circulating in the retinal blood vessels, as seen through the transparent tissues in front. The eyes are extremely sensitive to light and so the eyelids are kept partially closed, while blinking and a general wrinkling of the skin around the eyes are associated conditions which give to the albinotic individual a characteristic appearance. The hair on all parts is white, and all tissues, such as the brain and spinal cord, which in the normal individual are more or less pigmented, are in the albino completely devoid of this melanin.

In the normal individual this black pigment would seem to serve a useful purpose. In the case of the pigmented eye, the intensity of the light falling upon the retina is adequately diminished by the absorbing power of the retinal pigment, and this same melanin in the skin and hair, it is assumed with reason, protects the individual from the rays of the sun in tropical climes. The albino is seriously embarrassed in consequence of its deficiency, the albino animal much less so than the plant, however. Commonly in the breeding of corn or sorghum, when the self-fertilized seeds from an apparently normal green plant are sown, it is found that amongst the seedlings a number of spindling white plants make their appearance only to wither. They die because they lack the pigment chlorophyll, so essential in the manufacture of food, and therefore in the life of the plant. When the seeds of such an albino-producing plant are carefully sown and the number of chlorophyll-possessing and chlorophyll-lacking seedlings are counted, it is found that the greens outnumber the albinos by about three to one. From this it is known that the parent plant was heterozygous for its character green, that albinism in plants as in animals behaves in inheritance as a simple Mendelian recessive, and that in the case of these plants this character in the homozygous condition (*see* MENDELISM) is lethal, since in the absence of chlorophyll the plant cannot assimilate its food.

Albinism has been recorded in the great majority of the species, breeds, and varieties of domesticated animals and of cultivated plants. There are many records of instances of the condition among wild mammals and birds. In the case of mankind it has been observed in most races and probably occurs in all. Its frequency is not known, but it is estimated at perhaps one in 10,000. To-day it is possibly most frequent among the Indians of Arizona and Mexico. Whatever may be the exact frequency of the albinotic in a species, it is certain, since the condition behaves as a Mendelian recessive, that there are far more "carriers" than affected individuals in any race in which albinos appear, and that though originally the condition made its appearance as a "sport" or mutation, resulting from some definite change in the hereditary material of some one individual, since that time its reappearance in the stock is the result of the shuffling and reshuffling of the hereditary factors in their transmission from generation to generation and of the matings of apparently normal individuals who, however, are heterozygous for this particular character, not showing the taint but carrying it and transmitting it to their progeny.

The differently coloured races of a species all have albinotic strains and these may each possess the colour-bases or the ferments of the particular race to which it belongs. Albinos are all alike in that they are unpigmented, but they differ remarkably in respect of their unexpressed pigmentation. Properly planned breeding experimentation reveals the hidden. Pigmented races are not coloured uniformly: there is always some suggestion of a differential regional distribution of pigment, some indication of a pattern, and breeding experimentation has shown that the hereditary factors for the different patterns are transmitted from one generation to another quite independently of those which relate to the actual colour of the skin or coat. Thus it is that an albino that cannot exhibit a pattern because it has no colour can possess in its hereditary constitution factors for one or other of the various patterns. It is known, for example, that when a pure-bred self-coloured mouse is mated with an albino, the pattern of the coats of the offspring is determined by hereditary factors that are known to be absent from the self-coloured stock and to be present in the stock out of which the albino was derived.

So far, complete albinism only has been discussed. Partial albinism is also known, and a study of this condition reveals the fact that the interaction of colour-base and colour-developer is conditioned by such agencies as temperature. The Himalayan rabbit is an excellent example of partial albinism. In this breed the eye is pink and the fur of the body is unpigmented, but the ears, legs, tail, and nose are black. It has been shown that if an area of the white-furred body is shaved and the animal kept in the cold (5–9°C) the new fur that grows is black, whereas if the animal is kept in a warmed room, the new fur is white as before. The baby coat of the Himalayan is all white and the pattern develops after a few weeks when the young are moving freely about. But if the naked baby rabbit is taken from the rest for about ten minutes on two successive days and exposed to a temperature of about 17°C, and especially if it is sponged with cold water, the fur when it is developed later is black all over the body. It follows that the essential ingredients for pigmentation are present in all parts of the skin but that ordinarily the pigment is elaborated only in certain well-defined areas. The Himalayan is a self-coloured race, but the power to elaborate pigment at ordinary temperatures differs in different regions of the body, certain areas being albinotic because normally the temperature of these parts is not that at which the enzyme and colour-base which are undoubtedly present can in their interaction yield pigment.

In certain animals such as the arctic fox, the stoat or ermine, and several hares, and in certain birds, the ptarmigan for example, the pigmented pelage or plumage of the summer and autumn is replaced in the winter by a white one. In the case of the hare, it is held by some that the autumn coat is moulted completely and that the winter coat is a new growth; others hold that there is no moulting but that the autumn coat itself becomes unpigmented; still others are of the opinion that both processes are involved, a whitening of the old fibres and a new growth of non-pigmented fibres. In the ptarmigan the pigmented feathers certainly become white. It is probable that in the hare and similar forms the whiteness is due to the presence of air in the pigmented fibres and consequently to the irregular reflection of the light from the surfaces of these air bubbles. In the case of the ptarmigan it is possible that the whiteness of the winter plumage is due to a seasonal increase in the activity of the thyroid gland, for it is established that if the active principle of the thyroid gland is administered to pigmented domestic fowls, the new feathers as they grow tend to be non-pigmented. It has not yet been shown conclusively that

this seasonal change from the pigmented to the non-pigmented condition is to be regarded as an instance of seasonal albinism.

Occasionally albinotic frogs or axolotls are recorded, but it is doubtful whether all these cases are true examples of albinism. It is more probable that they are individuals in which the pituitary gland or hypophysis at the base of the brain is abnormal; for experiment has shown that if this gland is removed from these animals, the pigment cells in their skin no longer expand and that therefore the animals must preforce remain very pale in colour. An injection of the active principle of the gland, pituitrin, turns them coal-black almost at once. (*See* GENETICS; HEREDITY; COLOURS OF ANIMALS; MELANISM.)

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**ALBINOVANUS PEDO,** Roman poet, flourished during the Augustan age. He wrote a Theseis, referred to in a letter from his friend Ovid (*Ex Ponto*, iv. 10), epigrams which are commended by Martial (ii. 77, v. 5) and an epic poem (*cf.* Quintilian x. i. 90) on the exploits of Germanicus under whom he probably served (Tac. *Ann.*, i. 60). This may have been used as a source by Tacitus. All that remains of his works is a beautiful fragment, preserved in the *Suasoriae* (i. 15) of Seneca, describing the voyage of Germanicus (A.D. 16) through the river Ems to the Northern Ocean. Three elegies were formerly attributed to Pedo by Scaliger; two on the death of Maecenas (*In Obitum Maecenatis* and *De Verbis Maecenatis moribundi*), and one addressed to Livia (*Consolatio ad Liviam de Morte Drusi* or *Epicēdion Drusi*, usually printed with Ovid's works); but it is now generally agreed that they are not by Pedo. The *Consolatio* has been put down as the work of a 15th century Italian imitator, there being no mss. and no trace of the poem before the publication of the *edito princeps* of Ovid in 1471. There is an English verse translation of the elegies by Plumptre (1907).

*See* Haupt, *Opuscula*, i. (1875); Bährens, *Poetae Latini Minores* (1879) and *Fragmenta Poetarum Latinorum* (1886); Haube, *Beitrag zur Kenntnis des Albinovanus Pedo* (1880).

**ALBINUS, BERNARD SIEGFRIED** (1697–1770), was born at Frankfurt-on-the-Oder, and from 1718 to his death on Sept. 9, 1770, occupied the chair of anatomy, surgery and medicine at Leyden. He was the first to show by injections the connection of the vascular systems of the mother and the foetus. He also edited with Boerhaave the works of Vesalius and of Harvey. But he is chiefly famed for the excellent drawings in his *Tabula sceleti et musculorum corporis humani* (Leyden, 1747). His *De ossibus corporis humani ad auditores suos libellus* appeared at Leyden, 1726.

**ALBION,** the most ancient name of the British Isles, generally restricted to England (in Ptolemy Ἀλουίων; Lat. *Albion*, Pliny 4, 16 [30], 102). The name is perhaps Celtic but the Romans connected it with *albus*, white, in reference to the chalk-cliffs of Dover, and A. Holder (*Alt-Keltischer Sprachschatz*, 1896) translates it *Weissland*, "white-land." The early writer (6th century B.C.) whose *Periplus* is translated by Avienus (end of 4th century A.D.) does not use the name Britannia; he speaks of νῆσος Ἰέρνων καὶ Ἀλβιόνων ("island of the Ierni and the Albiones"). So Pytheas of Massilia (4th century B.C.) speaks of Ἄλβιον and Ἰέρνη.

**ALBION,** a city of Calhoun county, Mich., U.S., on the Kalamazoo river, 18 mi. W. of Jackson. It is on the Michigan Central railway, and is connected by buses with cities as far north as Grand Rapids and Owosso. The population was 10,395 in 1950 and was 8,345 in 1940 by the federal census. It has 16 factories. On a commanding site in the east part of the city is Albion college (Methodist Episcopal; coeducational), which has an enrolment of about 1,200 students. Albion was settled in 1831, incorporated as a village in 1866 and chartered as a city in 1885. A mayor-commission form of government was adopted by the city.

**ALBITE:** *see* FELSPAR.

**ALBOCARBON** or WHITE CARBON: *see* NAPHTHALENE.

**ALBOIN** (d. 573), king of the Lombards and barbarian conqueror of northern Italy, succeeded his father Audoin about 565. The Lombards at that time occupied Noricum and Pannonia, and were engaged in constant war with the Gepidae. Alboin obtained the alliance of the Avars, and with their help destroyed the Gepidae, slew their king, Cunimund, in battle and married his daughter, Rosamund. On April 1, 568, Alboin had assembled his people with a great number of allies, among them 20,000 Saxons, to cross the Alps and form a new settlement in Italy. There appears to be no truth in the legend that the Lombards were invited to attack Italy by the Byzantine general Narses. This was in effect a migration rather than a mere invasion The Roman defenses were overrun, Milan was occupied (Sept. 4, 569) and Pavia was invested. Lombard rule was established in northern Italy. But Alboin was murdered in 573 at the instigation of Rosamund, whom Alboin had insulted, so the story goes, by making her drink wine from her father's skull.

The authorities for the history of Alboin are Procopius, Paulus Diaconus and Agnellus (in his history of the church of Ravenna).

*See* Thomas Hodgkin, *Italy and Her Invaders*, vol. v (1916).

**ALBONI, MARIETTA** (1823–1894), Italian opera singer, was born at Cesena, Romagna, and studied at Bologna, where she became a pupil of G. A. Rossini. She had a magnificent contralto voice, and made her first appearance at La Scala, Milan, in 1843. In England her reputation was established by her appearance at Covent garden in 1847, and she had brilliant success both in Europe and in the United States. She lived in Paris from 1866 onward, and died at Ville d'Avray in 1894.

**ALBORADA** (*Span.*) signifies strictly a sunrise song or morning serenade akin to the French *aubade* (*q.v.*) but is now applied to a particular kind of instrumental music of a popular type to be heard in certain parts of Spain, the instruments employed being generally the bagpipes and side drum.

**ALBORNOZ, GIL ALVAREZ DE,** Spanish cardinal, was born at Cuenca early in the 14th century and died at Viterbo in 1367. He was made archbishop of Toledo in 1337 and cardinal in 1350. In 1353 Innocent VI sent him from Avignon as legate into Italy with a mission to secure the restoration of the papal authority in the states of the church. By 1362 he had paved the way for the return of Urban V to Rome. As legate, Albornoz showed himself to be an astute manager of men and an effective fighter. He began by making use of Cola di Rienzi, whose release from prison at Avignon he secured. After the murder of the tribune in 1354 Albornoz pursued his task of restoring the pope's authority by intrigue and force. A work by Albornoz on the constitution of the church of Rome, first printed at Jesi in 1473, is now very rare.

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**ALBRECHT,** the German form of Albert (*q.v.*).

**ALBRECHTSBERGER, JOHANN GEORG** (1736–1809), famous Austrian musical theorist and teacher, was born at Kloster-Neuburg, and died in Vienna. He studied composition under the court organist, Mann, and became one of the most learned and skilful contrapuntists of his age. In 1772 he was appointed organist to the court of Vienna, and in 1792 *Kapellmeister* of St. Stephen's cathedral. His fame attracted a large number of pupils, among whom were Beethoven, Johann Hummel and Ignaz Moscheles. His compositions, consisting of preludes, fugues and sonatas for the piano and organ, string quartets, etc., are of small importance, and most of them exist only in manuscript, being preserved in the library of the Vienna Gesellschaft der Musikfreunde. In 1790 he published at Leipzig his *Gründliche Anweisung zur Komposition*. A collection of his writings on harmony, in three volumes, was published under the care of his pupil Ignaz von Seyfried (1776–1841) in 1826 (English version 1855).

**ALBRET,** the name of a powerful French family, originating in Labrit, a small village in the Landes of Gascony, on the main road from Bordeaux to Dax and to Bayonne, which it owned in the 10th century. The lord of Albret spread his power by degrees over the surrounding country, obtaining many lordships in Bazadais, Condomois, Bordelais and the countries of the Adour. The family of Albret was divided between several branches. The most powerful of these branches, the eldest, played an important part during the Hundred Years' War and at the beginning of the modern period. Arnaud-Amanieu fought the English troops in Guienne victoriously after 1369 and married Margaret of Bourbon, King Charles V's sister-in-law. His son Charles became constable of France, but was killed at the battle of Agincourt in 1415. Family alliances caused Alain d'Albret, the Great, to be one of the most powerful French lords at the end of the 15th century, and the power of his house was still further increased in the 16th: its head became king of Navarre and prince of Bearn through the marriage of Jean d'Albret, Alain's son, to Catherine of Foix-Grailly; and its patrimonial lands were raised to the rank of duchy (1555). Lastly, a great-granddaughter of Alain the Great, Jeanne, married Antoine de Bourbon; and their son, after the dynasty of the Valois had ceased to be, became king of France as Henry IV.

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**ALBUERA, LA** (or ALBUHERA), a small village of Spain, in the province of Badajoz, 13 mi. S.E. of the town of that name, insignificant in itself but celebrated because of the victory gained there on May 16, 1811, by the British, Portuguese and Spaniards, under Viscount Beresford, over the French army commanded by Marshal N. J. de Dieu Soult. Pop. (1940) 1,909.

After Portugal had been cleared of the French invading army under André Masséna, Wellington sought to secure his position by recovering the frontier fortresses. He himself invested Almeida while Beresford was sent, with 10,000 Spaniards, 9,000 Portuguese and 9,000 British only, to lay siege to Badajoz. But the latter was hardly in position before Soult moved upon him from the south with 27,000 veterans. Beresford took up a covering position at Albuera, astride the road to Badajoz, but his dispositions were faulty and Masséna, feinting at a direct thrust down the road, made a concealed manoeuvre round the allied right flank. There the Spanish were cut to pieces or dispersed, a British brigade, hurrying to their aid, was annihilated by the French cavalry, and only a thin line of 1,800 British "redcoats" strung out on a ridge intervened between the French mass of manoeuvre and complete victory. Thin as it was, being a line, it overlapped the front of the massed French columns, and thus gained full value from its fire. For half an hour both sides poured a heavy musketry fire into each other's ranks at point-blank range, and then the nerves of the French snapped under the exorbitant toll, and their columns rolled back down the slopes, gaining momentum as they went until their retirement became a rout. The French losses were about 8,000, and those of the British 4,000 in all, while the Spaniards lost 1,400. Strategically, Beresford's decision to fight was a mistake, for the siege had already been abandoned on Soult's approach; it exposed him to disaster when isolated, and even as it was the losses grievously impaired Wellington's strength. But morally, it had a vital influence on subsequent encounters.

**ALBUFERA DE VALENCIA,** lagoon, 7 mi. S. of Valencia in Spain, about 12 mi. long, 14 mi. broad and 12 ft. deep (max.), with a narrow outlet to the sea under control. It is rich in fish and wild fowl; rice is grown around it. Napoleon made Marshal L. G. Suchet duke of Albufera (1812) after the conquest of Valencia. After the battle of Vittoria (1813) he lost the domain but kept the title. Later, the Spanish nation gave the revenues of Albufera to the duke of Wellington.

**ALBULA PASS,** the principal route from the north to the Upper Engadine in the Grisons. It was used in the 13th century and a carriage road (highest point, 7,595 ft.) was made across it in 1865, but for a long time it was not so much used as the easier and more direct Julier pass (7,504 ft.). The opening of the railway in 1903, however, vastly increased its importance. Starting from Coire the railway follows the Rhine to Reichenau (6¼ mi.), and then the Hinter Rhine to Thusis (10½ mi.). It then runs through the grand Schyn gorge (cut by the Albula torrent) to Tiefenkastell (7½ mi.), where it leaves the Julier road on the right (south) and continues to follow the course of the Albula past Filisur and Bergün (12½ mi.) to the mouth (5,879 ft.) of the tunnel (¾ mi. in length; highest point, 5,987 ft.) which has been pierced below the pass. The railway descends through the Bevers glen to Bevers (2½ mi.), in the Upper Engadine, about 5 mi. below St. Moritz, which is 56 mi. from Coire by this route.

**ALBUM,** in ancient Rome, a board chalked or painted white, on which public notices were inscribed in black. The *Annales Maximi* of the Pontifex Maximus, the annual edicts of the praetor, the lists of senators and jurors, the *Acta Diurna,* etc., were exhibited in this manner. In modern times "album" denotes a book of blank pages in which autographs, sketches or the like are collected. In law, the word is the equivalent of *mailles blanches,* for rent paid in silver ("white") money.

**ALBUMAZAR** or properly ABU-MAASCHOR (805–885), Arab astronomer, was born at Balkh, flourished at Baghdad and died at Wasid in central Asia. His principal works were translated into Latin: *De Magnis Conjunctionibus* (Augsburg, 1489), *Introductorium in Astronomiam* (Venice, 1506) and *Flores Astrologici* (Augsburg, 1488). He maintained in the first that the world, created when the seven planets were in conjunction in the first degree of Aries, will come to an end at a like conjunction in the last degree of Pisces. Albumazar's name is used for the subject of *L'Astrologo* by Gian Battista del Porta (1606), a play which was adapted in *Albumazar* by John Tomkis, played before James I in 1614, revived by J. Dryden in 1748.

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**ALBUMINOIDS:** *see* PROTEINS.

**ALBUMINS:** *see* PROTEINS.

**ALBUMINURIA** is the name for the condition in which the urine contains abnormal amounts of albumin. Other proteins and similar compounds such as albuminoses and proteoses occasionally also are found in the urine, and these conditions are called proteinurias. Excessive loss of protein from the body produces serious physiologic changes, and even the loss of small amounts may profoundly affect its metabolism. Therefore, the detection of albumin in the urine is of great diagnostic importance, for its presence may indicate serious pathologic changes in the body, particularly in the kidneys.

The urine may contain red blood cells or haemoglobin, a protein found in red blood cells, but these conditions are not classified as albuminuria. Although the urine normally contains minute amounts of albumin, under normal conditions the kidneys do not permit the escape of appreciable amounts of the blood proteins. However, when the kidneys are diseased, particularly in nephritis (*see* KIDNEY, DISEASES OF), their ability to prevent the loss of protein is seriously affected and these substances appear in readily detectable amounts in the urine. In severe albuminuria the loss of protein may be from one gram to two grams per 100 c.c. of urine.

Protein may also appear in the urine as a result of injury or disease of parts of the urinary tract other than the kidneys, and is referred to as "accidental," "false" or "postrenal" albuminuria.

The diagnosis of albuminuria is made by means of chemical tests which result in precipitation and coagulation of the protein dissolved in the urine. Usually in these tests acids, such as nitric, sulphosalicylic or acetic, are added to the urine, and when this is done, protein, if present in the urine, will form a white or cream-coloured precipitate. The use of heat when the urine is acid also will cause the coagulation of protein. Determination of the amount of protein in the urine requires more elaborate chemical tests which usually depend upon chemical analysis for nitrogen in the precipitated protein.

Under certain conditions, the urine of individuals apparently quite healthy may contain albumin (physiologic albuminuria). The most common causes are strenuous muscular exercise, excessive protein in the diet or exposure to cold. Protein is also commonly found in the urine of infants and in urine in the later stages of pregnancy. The appearance of albuminuria may be intermittent (paroxysmal albuminuria) and without obvious cause. A special example of physiologic albuminuria is orthostatic or postural albuminuria, which dis-

appears when the patient remains in bed but reappears when the patient gets up.

The chief significance of albuminuria is in reference to nephritis in which, characteristically, albumin appears in the urine. Frequently, however, during the course of the disease, protein is absent and a careful study is necessary in order to evaluate properly the urinary findings. Repeated tests are usually necessary before the signs and symptoms of the patient can be correlated with the presence or absence of albuminuria.

A special proteose, known as Bence Jones protein, may rarely be found in the urine. It occurs in connection with certain diseases, such as a cancer of the bone called multiple myeloma (*see* CANCER), and similar proteoses may also be found in the urine of persons ill with leukemia, osteomalacia and myxoedema. The presence of Bence Jones protein in the urine can be determined because, unlike albumin, the white precipitate which forms in the presence of heat and acetic acid at 60° C. dissolves when the temperature is raised to 100° C., again to reappear when the mixture is cooled. Albumin remains in the precipitated form at the temperature of 100° C.

The presence of albuminuria is so significant and serious that insurance companies usually will not insure persons who have this condition, although in the light of present knowledge of transient and physiologic albuminuria a more lenient attitude on the part of insurance companies is evident. (T. B. M.)

**ALBUQUERQUE, ALPHONSO D'** (in old Portuguese AFFONSO D'ALBOQUERQUE), (1453–1515), surnamed THE GREAT, and THE PORTUGUESE MARS, was born in 1453 at Alexandria, near Lisbon, and educated at the court of Alphonso V. In 1503 he set out on his first expedition to the east. He sailed round the Cape of Good Hope to India, where he obtained from the king of Cochin permission to build a Portuguese fort. He returned home in July 1504, and King Emmanuel gave him the command of a squadron of five vessels in the fleet of 16 which sailed for India in 1506 under Tristão da Cunha. After a series of attacks on the Arab cities on the east coast of Africa, Albuquerque separated from Da Cunha and captured (Sept. 1507) the island of Ormuz, in the Persian gulf, which was then one of the chief centres of commerce in the east. He was unable long to maintain his position.

With his squadron increased by three vessels, he reached the Malabar coast at the close of 1508, and produced a commission from the king empowering him to supersede the governor Francisco de Almeida. The governor's reply was imprisonment, from which Albuquerque was released only on the arrival of the grand marshal of Portugal with a large fleet. An unsuccessful attack upon Calicut in Jan. 1510 was immediately followed by the investment and capture of Goa. Albuquerque abandoned the town in August, to return with the reinforcements in November, when he obtained undisputed possession. He next directed his forces against Malacca, which he subdued after a severe struggle. He remained in the town nearly a year to consolidate the position. In 1512 he sailed for the coast of Malabar. On the voyage, Albuquerque's vessel, the "Flor de la Mar," which carried the treasure he had amassed in his conquests, was wrecked, and he himself barely escaped with his life. In September of the same year he arrived at Goa, where he quickly suppressed a serious revolt headed by Idalcan.

Albuquerque had been for some time under orders from the home government to undertake an expedition to the Red sea, in order to secure that channel of communication exclusively to Portugal. He accordingly laid siege to Aden in 1513, but was repulsed; a voyage into the Red sea, the first ever made by a European fleet, led to no substantial results. His last success was the recapture in 1515 of the island of Ormuz, which remained in the possession of the Portuguese until 1622. Albuquerque had several enemies at the Portuguese court, and on his return from Ormuz, at the entrance of the harbour of Goa, he met a vessel from Europe bearing dispatches announcing that he was superseded by his personal enemy, Soarez. He died at sea on Dec. 16, 1515. Before his death he wrote a letter to the king in dignified and affecting terms, vindicating his conduct and claiming for his son the honours and rewards due to himself.

His body was buried at Goa, and it is, perhaps, the most convincing proof possible of the justice of his administration that, many years after, Moslems and Hindus used to go to his tomb to invoke protection against the injustice of his successors. His natural son Affonso published a selection from his father's papers under the title *Commentarios do Grande Affonso d'Alboquerque.*

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**ALBUQUERQUE, MATHIAS DE** (d. 1647), Portuguese general, was governor of Pernambuco in 1624 and, after the Dutch captured Bahia, governor general of North Brazil. As governor in Pernambuco again in 1629 he had to meet the Dutch invasion of that province, and in 1630 was forced to surrender Olinda and the forts of the Recif. Sent back to Portugal in disgrace in 1635, he took part later in the Portuguese War of Liberation, defeating the Spaniards under Mölingen at Montijo, on May 26, 1644, and thereby earning the title of count of Allegrete. He died at Lisbon June 9, 1647.

**ALBUQUERQUE,** the largest city of New Mexico, U.S., is in the valley of the Rio Grande, at an altitude of 5,196 ft., in the approximate centre of the state. It is the county seat of Bernalillo county and a division point on the Santa Fe railway. It is on federal highways 66 and 85, and is also served by bus and air lines. Population by the federal census of 1950 was 97,012; in 1940 it was 35,449. The bracing climate and the large proportion of sunshiny days have given it a reputation as a health resort, and it has several private sanatoria for the treatment of tuberculosis.

Albuquerque distributes vast quantities of supplies and material of all kinds to the sheep and cattle industry, to mining and timbering operations and to smaller cities and towns throughout the state. A large air force base (Kirtland field) is located there, as is Sandia base of the Atomic Energy commission.

Among items manufactured and processed in Albuquerque are brick and tile, concrete pipe, truck bodies, trailers, furniture, chemicals, clothing, batteries, brushes, caskets, precision machinery, playground equipment, leather goods, fabricated iron and steel, felt and cloth emblems, flour, candy, ice cream and dairy products, lumber, mattresses, meat products, metal tanks and culverts, signs, optical goods, sashes and doors, tents and awnings. In addition, the Santa Fe railway maintains large railroad shops.

Albuquerque is the seat of the University of New Mexico (opened in 1892), with a registration of approximately 4,600 students in 1951. An adaptation of the pueblo style of architecture has been used in the university buildings.

Within easy motoring distance are the Indian pueblos of San Felipe, which has a church built by Fray Cristóbal de Quinones (d. 1609); of Isleta and Santo Domingo, where fine ceremonial dances are performed; of picturesque Laguna, with its interesting mission church; and of Acoma, perched on a precipitous mesa 357 ft. high, which was already very old when Fray Marcos arrived in 1539.

The "old town," which lies along the river bank, was founded in 1706 by Don Francisco Cuervo y Valdes, and named by him after the duke of Alburquerque, a viceroy of New Spain. The duke ordered the name to be changed to San Felipe de Alburquerque, as a compliment to the reigning king. With the passage of time it became reduced to one word, and that word lost one of its "r's."

The mission church of San Felipe de Neri (1735) is still standing, and the entire district keeps its old Spanish character. It was an important centre in the Spanish and the Mexican occupations.

During the Civil War it was occupied by Confederate troops (Feb. 1862) under Gen. Henry Hopkins Sibley, who soon afterward advanced into northern New Mexico. In his retreat into Texas he made a stand there, on April 8, 1862, against a detachment of Union troops commanded by Col. R. S. Canby.

The modern city was founded in 1879; the railway reached it in 1880; by 1890 it had a population of 3,785. A city-manager form of government was adopted later.

**ALBURY,** a small country town of rising importance in Goulburn county, New South Wales, Austr. Situated at an elevation of 542 ft. on the right (north) bank of the river Murray,

approximately 1,470 mi. from its mouth, Albury marks the head of possible navigation (July-December) on this stream, though infrequent river steamers normally ply only as far as Echuca. Its position, again, on the western flank of the eastern highlands, not far from the point of debouchment of the Murray, and in the general line of connection between Melbourne and Sydney, constitutes Albury a crossing-place of some importance. As a fording point it has figured in the history of Australian exploration. In 1883 the Victoria and New South Wales railway systems were connected at this point, and Albury is now a bridge town on the main line linking Victoria and New South Wales (Albury–Sydney *c.* 350 mi., Albury–Melbourne *c.* 190 mi.), and also the eastern and western portions of the continent (Transcontinental line, Fremantle and Perth-Brisbane). The river is crossed by means of an iron bridge from Wodonga on the Victorian side, and here also is a break of gauge (Victorian system: 5′ 3″; N.S.W.: 4′ 8½″). A little above Albury is the confluence of the Murray with its tributary the Mitta Mitta. Albury, therefore, figures in the now historic River Murray Agreement (1914), and it has acquired further considerable importance as a result of the execution of the schemes under that agreement, such as the nearby Hume reservoir. Albury, which has a mean annual temp. of 60.7°, mean annual rainfall of 27.65 in., of which 18.9 in. falls in the seven months, April–October, is the centre and virtual capital of the eastern Riverina, a rich agricultural and pastoral district producing wheat, fruit and sheep. Albury became a municipality in 1859, and has shown a steady rise in population (1891, 5,447; 1921, 7,752; 1933, 10,543).

**ALCAEUS** or **ALKAIOS** (*c.* 600 B.C.), Greek poet, holds second place in the Alexandrian lyric canon. He was a contemporary of Sappho, and a member of one of the noble families of Mitylene.

In the war against the Athenians (606), he fled from battle with the loss of his shield. His political enemies drove him into exile, but towards the end of his life he is said to have been pardoned by Pittacus. His poems, which were written in the Aeolic dialect, included hymns; political poems (*stasiōtica*), in which he abused the tyrants, his political enemies; love-songs; and drinking-songs. He seems to have invented the Alcaic metre, and was regarded as a model by Horace.

*See* Bergk, *Poetae Lyrici Graeci* (1882); also *The Songs of Alcaeus*, by J. Easby-Smith (Washington, 1901); Plehn, *Lesbiacorum Liber* (1826); Flach, *Geschichte der griechischen Lyrik* (1883–84); Farnell, *Greek Lyric Poets* (1891). New fragments edited by J. M. Edmonds (1909). *See* also Edgar Lobel, Ἀλκαίου Μέλη, *the Fragments of the Lyrical Poems of Alcaeus* (Oxford, 1928).

**ALCAICS,** the name of several lyric verses, from Alcaeus of Lesbos, their supposed inventor. They comprise:

(1) Alcaic hendecasyllable: ⏑ – ⏑ – ⏑ – ⏑ ⏑ – ⏑ –
Examples: Latin, "odi profanum volgus et arceo."
English imitation, "O mighty-mouthed inventor of harmonies."

(2) Alcaic decasyllable: – ⏑ ⏑ – ⏑ ⏑ – ⏑ – ⏑
Examples: Latin, "virginibus puerisque canto."
English imitation, "Milton, a name to resound for ages."

(3) Alcaic enneasyllable: ⏑ – ⏑ ⏑ – ⏑ ⏑ – ⏑
Examples: Latin, "audita Musarum sacerdos."
English imitation, "God-gifted organ-voice of England."

The Alcaic stanza consists of (1) twice repeated, followed by (3) and then (2), once each. It was a great favourite, not only of its inventor, but of Horace, who made some very slight modifications to adapt it to Latin. In modern languages it has been imitated by Tennyson (from whom the above English lines are taken) and occasionally by poets in other languages, but never with much success.

The manner in which the lines should be divided into feet is, in this as in all "Aeolic" metres, a highly controversial point.

**ALCAIDE,** a Spanish title meaning the governor of a fortress (Arabic *al-quāid*).

**ALCALÁ** (Moorish *al kala*, the "Fortress" or "Castle"), the name of thirteen Spanish towns, all founded or named by the Moors. Alcalá de Henares, pop. (1940) 18,013, is separately described on account of its historical importance. Alcalá la Real (8,437), a picturesque town with a fine abbey, is situated in the mountainous south-west part of Jaén. Its distinctive name *la Real*, "the Royal," was conferred in memory of its capture by Alphonso XI. of Leon in 1340. In 1810 the French under Count Sebastiani here defeated the Spaniards. Alcalá de los Gazules (6,135), on the river Barbate, in the province of Cadiz, trades in cork and agricultural produce. Alcalá de Guadaira (17,758), on the river Guadaira, near Seville, is popularly called Alcalá de los Panaderos, or "Alcalá of the Bakers," because it supplies Seville with large quantities of bread; it also manufactures for export the best "Seville oil."

**ALCALÁ DE HENARES,** Spain, 17 mi. E.N.E. of Madrid, on the river Henares. Pop. (1940) 18,013 (mun., 18,419). Alcalá de Henares contains a military academy. The town has been identified with the Roman *Complutum*, destroyed about 1000, and rebuilt by the Moors in 1083. Later its university, founded by Cardinal Jimenes de Cisneros in 1510, was second only to that of Salamanca. Here the famous *Complutensian Polyglot* Bible was prepared from 1514 to 1517. The college of San Ildefonso completed in 1583, was the chief university building. Its modernized Gothic church, the Colegiata, contains the 16th century marble monument of Jimenes (d. 1517) and a fine reredos.

On the removal of the university to Madrid in 1836 the town declined, and the university buildings became archives of state departments and of the Inquisition. One of the principal libraries is the former palace of the archbishops of Toledo.

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**ALCALDE,** the title in Spanish for officials of somewhat varied functions in which, however, there is always a judicial element. *Alcalde de corte* was a judge of the palace court, having jurisdiction in and about the residence of the king. But the title is now exclusively used for the mayor of a town or village who discharges the functions of a justice of the peace. The title of *alcalde* must be carefully distinguished from *alcaide* (*q.v.*) which means the governor of a fortress.

**ALCAMENES,** a Greek sculptor of Lemnos and Athens. He was a younger contemporary of Pheidias and noted for the delicacy and finish of his works, among which a Hephaestus and an Aphrodite "of the Gardens" were conspicuous. Pausanias says (v. 10, 8) that he was the author of one of the pediments of the temple of Zeus at Olympia (*see* GREEK ART), but this seems a chronological and stylistic impossibility. At Pergamum there was discovered in 1903 a copy of the head of the Hermes "Propylaeus" of Alcamenes (*Athenische Mittheilungen*, 1904, p. 180). It is safer, however, to judge him by the sculptural decoration of the Parthenon, in which he must almost certainly have taken a share under the direction of Pheidias.

**ALCAMO,** province of Trapani, Sicily, 24 mi. W.S.W. of Palermo direct (51½ mi. by rail). Pop. (1936) 38,129 (town), 38,396 (commune). The Saracenic chief Al-Kamuk erected the castle (A.D. 828), considerably altered since. Frederick II removed the site lower down (1233). The surrounding district is very fertile.

**ALCÂNTARA,** a small seaport of Brazil, in the State of Maranhão, on the west shore of the bay of São Marcos, 16 mi. from the city of São Luiz by water. It has a fairly good harbour, and excellent cotton and rice are grown in the vicinity and shipped from the port.

**ALCÁNTARA,** western Spain, province of Cáceres, on a rocky height on the left bank of the river Tagus, 7 mi. from the Portuguese frontier. Pop. (1940) 4,404 (mun., 4,657). Alcántara (in Arab. "the bridge") owes its name to the magnificent Roman bridge which spans the Tagus on the northwest, built about A.D. 105, in honour of the emperor Trajan and at the cost of eleven Lusitanian communities. A small temple, dedicated to Trajan and other deified emperors, adjoined the bridge on the left bank. Though it has been identified with Norba Caesarea and with Interamnium, it is doubtful whether there was a Roman town here. It became famous about 1215 as the stronghold of the knights of Alcántara, many of whose grand masters lie buried in the 13th-century Gothic church.

**ALCAVALA,** a duty charged in Spain and its colonies until the invasion of Napoleon (from Arab. *al-quabalah,* "tax," *quabala,* "to receive"; *cf.* Fr. *gabelle*). Originally imposed in 1341 by Alphonso XI. to secure freedom from the Moors, it was an *ad valorem* tax of 10%, increased afterwards to 14%, on the selling price of all commodities, whether raw or manufactured, and chargeable as often as they were sold or exchanged. This was a monstrous imposition which subjected every farmer, manufacturer, merchant and shopkeeper to the continual visits and examination of the tax-gatherers, whose number was necessarily very great.

**ALCAZAR, B. DEL** (1530–1606), Spanish poet, was born at Seville. He served under the Marqués de Santa Cruz and afterwards in the households of the Duque de Alcala and of the Conde de Gelves. Alcazar belonged to the Italianate school and modelled himself on Martial. The grace and cynicism of Baltasar del Alcazar are manifested in his *Poesias* (ed. F. R. Marin, 1910).

**ALCÁZAR DE SAN JUAN** or **ALCÁZAR,** Spain, province of Ciudad Real, and an important railway junction, where the lines to the east and south-east diverge from the main line to Andalusia. Pop. (1940) 23,083 (mun., 26,141). Alcázar trades in wine and manufactures soap, gunpowder, chocolate and inlaid daggers. It is sometimes identified with the Roman *Alce,* captured by Tiberius Sempronius Gracchus in 180 B.C. It derives its name from its mediaeval Moorish castle (*al-kasr*), afterwards garrisoned by the knights of St. John. The entire district is associated with Cervantes and with the action of *Don Quixote* (El Toboso, 12 mi. E.N.E.; Argamasilla de Alba, 22 mi. S.E.). Local antiquaries even identify the knight with Don Rodrigo de Pacheco, whose portrait adorns the parish church.

**ALCESTER, FREDERICK BEAUCHAMP PAGET SEYMOUR,** BARON (1821–95), British admiral, was born April 12, 1821. Entering the navy in 1834, he served in the Mediterranean and the Pacific, was for three years flag-lieutenant to his uncle Sir George Seymour, and was promoted to be commander in 1847. He had a distinguished naval record and held a series of high commands. In 1880–83 he was commander-in-chief of the fleet in the Mediterranean, and in 1880 had also the chief command of the European squadron sent to the coast of Albania as a demonstration to the Porte to cede Dulcigno to Montenegro. In July 1882 Admiral Seymour commanded at the bombardment of Alexandria and in the subsequent operations on the coast of Egypt, for which service he was raised to the peerage, received a parliamentary grant of £25,000, the freedom of the City of London and a sword of honour. He retired from the service in 1886, and died in London, March 30, 1895.

**ALCESTER** (aul'stur), a market-town, Warwickshire, England, 16 mi. W.S.W. of Warwick on the G.W. and L.M.S. railways. Population of rural district (1938) 11,610. It is situated at the junction of the small stream Alne with the Arrow, a northern tributary of the Avon.

The name (Alnecestre, Alyncester) signifies "the camp on the Alne." A small Romano-British town or village was situated here on the road which ran from Derby to join the Fosse Way near Cirencester. Pavements, potsherds, coins and burials have been found, but nothing to indicate an important station. No written document relating to Alcester exists before the reign of Henry I. when it seems to have been a royal borough, but the title of borough soon lapsed. In the reign of Henry III. a moiety of the manor was purchased by Sir Walter Beauchamp, who granted a charter establishing a Tuesday market for corn, cattle and all kinds of merchandise, and also obtained grants of fairs. In 1444 Sir John Beauchamp purchased the remaining moiety of the manor, and was granted an additional fair. From this date the Beauchamps were lords of the whole manor until it passed by female descent to the Grevilles in the reign of Henry VIII. In 1140 a Benedictine monastery was founded here by Ralph Boteler of Oversley, and received the name of the Church of Our Lady of the Isle, owing to its insulation by a moat meeting the River Arrow. The monastery was suppressed among the smaller houses in 1536. Traces of the moat and the foundations are still to be seen in Priory Close. The ancient fairs survived to the end of the 19th century. The church of St. Nicholas was rebuilt in 1734.

The manufacture of needles, which employed nearly 1,000 hands in 1830, is now unimportant, having been absorbed into the centre of the industry at Redditch, but needle stamping and scouring are carried on. There are implement and cycle works, metal glazing and polishing being a special feature.

**ALCESTIS,** in Greek legend, the wife of Admetus (*q.v.*).

**ALCHEMY.** In the narrow sense of the word, alchemy is the pretended art of making gold and silver, or transmuting the base metals into the noble ones. The idea of such transmutation probably arose among the Alexandrian Greeks in the early centuries of the Christian era; thence it passed to the Arabs, by whom it was transmitted to western Europe. Its realization was a leading aim of chemical workers down to the time of Paracelsus and even later. Alchemy in its wider and truer significance stands for the chemistry of the middle ages. The idea of transmutation, in the country of its origin, had a philosophical basis, and was linked up with the Greek theories of matter there current. Thus, by supplying a central philosophical principle, it to some extent unified and focused chemical effort, which previously, so far as it existed at all, had been expended on acquiring empirical acquaintance with a mass of disconnected technical processes. Alchemy in this sense is merely an early phase of the development of systematic chemistry; in Liebig's words, it was "never at any time anything different from chemistry."

Regarding the derivation of the word, there are two main views which agree in holding that it has an Arabic descent, the prefix *al* being the Arabic article. But according to one, the second part of the word comes from the Greek χυμεία, pouring, infusion, used in conjunction with the study of the juices of plants, and thence extended to chemical manipulations in general; this derivation accounts for the old-fashioned spellings "chymist" and "chymistry." The other view traces it to *khem* or *khamé,* hieroglyph *khmi,* which denotes black earth as opposed to barren sand, and occurs in Plutarch as χυμεία. On this derivation alchemy is explained as meaning the "Egyptian art"; *i.e.,* the art of the black land. The first occurrence of the word is said to be in a treatise of Julius Firmicus, an astrological writer of the 4th century, but the prefix *al* there must be the addition of a later copyist. In English, *Piers Plowman* (1362) contains the phrase "experimentis of alconomye," with variants "alkenemye" and "alknamye." The prefix *al* begins to be dropped about the middle of the 16th century.

**Origins of Alchemy.**—Numerous legends cluster round the origin of alchemy. According to one story, it was founded by the Egyptian god Hermes (Thoth), the reputed inventor of the arts and sciences; after him later alchemists called their work the "hermetic art," and the seal of Hermes, which they placed upon their vessels, is the origin of the common phrase "hermetically sealed." Another legend asserts that the fallen angels taught the arts to the women they married, their instruction being recorded in a book called *Chemā.* A similar story appears in the Book of Enoch, and Tertullian has much to say about the wicked angels who revealed to men the knowledge of gold and silver, of lustrous stones and of the power of herbs, and who introduced the arts of astrology and magic upon the earth. Another legend to be found in Arabic sources, asserts that alchemy was revealed by God to Moses and Aaron. But there is some evidence that, in accordance with the strong and constant tradition among the alchemists, the idea of transmutation did originate in Egypt with the Greeks of Alexandria. In the Leyden museum there are a number of papyri which were found in a tomb at Thebes in 1828, written probably in the 3rd century A.D., though their matter is much older. Some are in Greek and demotic, and one, of peculiar interest from the chemical point of view, gives a number of recipes, in Greek, which show a considerable knowledge in the manipulation of base metals to form alloys which simulate gold, and are intended to be used as a workshop manual in the manufacture of imitation jewellery. Possibly this is one of the books about gold and silver of which Diocletian decreed the destruction about A.D. 290. It has been suggested by M. P. E. Berthelot (*q.v.*) that the workers in

these processes, which were a monopoly of the priestly caste and were kept strictly secret, though fully aware that their products were not truly gold, were in time led by their success in deceiving the public to deceive themselves also, and to come to believe that they actually had the power of making gold from substances which were not gold. Philosophical sanction and explanation of this belief was then found by bringing it into relation with the theory of the *prima materia,* which was identical in all bodies but received its actual form by the adjunction of qualities expressed by the Aristotelian elements—earth, air, fire and water. Some support for this view is gained from study of the alchemistical writings of the period. Thus, in the treatise known as *Physica et Mystica* and falsely ascribed to Democritus (such false attributions are a constant feature of the literature of alchemy), various recipes are given for colouring and gilding metals, but the conception of transmutation does not occur. This treatise was probably composed at a date not very different from that of the Leyden papyrus. Later, however, as in the *Commentary* on this work written by Synesius to Dioscorus, priest of Serapis at Alexandria, which probably dates from the end of the 4th century, a changed attitude becomes apparent. The more practical parts of the recipes are obscured or omitted, and the processes for preparing alloys and colouring metals, described in the older treatise, are by a mystical interpretation represented as resulting in real transmutation.

But while there are thus some grounds for supposing that the idea of transmutation grew out of the practical recipes of Alexandrian Egypt, the alchemy which embraced it as a leading principle was also much affected by eastern influences such as magic and astrology. The earliest Greek alchemistical writings abound in references to oriental authorities and traditions. Thus the pseudo-Democritus, who was the reputed author of the *Physica et Mystica,* which itself concludes each of its recipes with a magical formula, was believed to have travelled in Chaldaea, and to have had as his master Ostanes the Mede, a name mentioned several times in the Leyden papyrus, and often by early Christian writers such as Tertullian, St. Cyprian and St. Augustine. The practices of the Persian adepts also are appealed to in the writings of the pseudo-Democritus, and of Zosimus and Synesius. The philosopher's egg, as a symbol of creation, is both Egyptian and Babylonian. In the Greek alchemists it appears as the symbol at once of the art and of the universe, enclosing within itself the four elements. The conception of man, the microcosm, containing in himself all the parts of the universe or macrocosm, is also Babylonian, as again probably is the famous identification of the metals with the planets. Even in the Leyden papyrus the astronomical symbols for the sun and moon are used to denote gold and silver, and in the *Meteorologica* of Olympiodorus lead is attributed to Saturn, iron to Mars, copper to Venus, tin to Hermes (Mercury) and electrum to Jupiter. Similar systems of symbols, but elaborated to include compounds, appear in Greek mss. of the 10th century, preserved in the library of St. Mark's at Venice. Subsequently electrum (an alloy of gold and silver) disappeared as a specific metal, and tin was ascribed to Jupiter instead, the sign of mercury becoming common to the metal and the planet.

**Literature of Alchemy.**—A considerable body of Greek chemical writings is contained in mss. belonging to the various great libraries of Europe, the oldest being that at St. Mark's, just mentioned. The contents of these mss. are all of similar composition, and in Berthelot's opinion represent a collection of treatises made at Constantinople in the 8th or 9th century. The treatises are nearly all anterior to the 7th century, and most appear to belong to the 3rd and 4th centuries; some are the work of authentic authors like Zosimus and Synesius, while others, such as profess to be written by Moses, Democritus, Ostanes, etc., are of clearly fictitious authorship. Some of the same names and the same works can be identified in the lists of the *Kitáb-al-Fihrist* (written by al-Nadim toward the end of the 10th century). But the Arabs did not acquire their knowledge of this literature at first hand. The earliest Hellenic culture in the east was Syrian, and the Arabs made their first acquaintance with Greek chemistry, as with Greek philosophy, mathematics, medicine, etc., by the intermediary of Syriac translations. (*See* ARABIAN PHILOSOPHY and SYRIAC LITERATURE.) Examples of such translations are preserved in mss. at the British museum, partly written in Syriac, partly in Arabic with Syriac characters. In Berthelot's opinion, the Syriac portion represents a compilation of recipes and processes undertaken in the Syrian school of medicine at Baghdad under the Abbasids in the 9th or 10th century, and to a large extent constituted by the earlier translations made by Sergius of Resaena in the 6th century. They contain, under the title *Doctrine of Democritus,* a fairly methodical treatise in ten books comprising the *Argyropoeia* and *Chrysopoeia* of the pseudo-Democritus, with many recipes for colouring metals, making artificial precious stones, effecting the *diplosis* or doubling of metals, etc. They give illustrations of the apparatus employed, and their close relationship to the Greek is attested by the frequent occurrence of Greek words and the fact that the signs and symbols of the Greek alchemists appear almost unchanged. The other portion seems of somewhat later date. Another Syriac ms., in the library of Cambridge university, contains a translation of a work by Zosimus which is so far unknown in the original Greek. Berthelot gives reproductions of the British Museum mss. in vol. ii of *La Chimie au moyen âge.*

Several alchemistical treatises, written in Arabic, exist in manuscript in the National Library at Paris and in the library of the University of Leyden, and have been reproduced by Berthelot, with translations, in vol. iii of *La Chimie au moyen âge.* They fall into two groups: those in one are largely composed of compilations from Greek sources, while those in the other have rather the character of original compositions. Of the first group the most interesting and possibly the oldest is the *Book of Crates;* it is remarkable for containing some of the signs used for the metals by the Greek alchemists, and for giving figures of four pieces of apparatus which closely resemble those depicted in Greek mss., the former being never, and the latter rarely, found in other Arabic mss. Its concluding words suggest that its production was due to Khalid ben Yezid (died in 708), who was a pupil of the Syrian monk Marianus, and according to the *Kitáb-al-Fihrist* was the first Moslem writer on alchemy. The second group consists of a number of treatises professing to be written by Jabir, celebrated in Latin alchemy as Geber (*q.v.*). Internal evidence suggests that they are not all from the same hand or of the same date, but probably they are not earlier than the 9th nor later than the 12th century. The Arabic chroniclers record the names of many other writers on alchemy, among the most famous being Rhazes and Avicenna who were physicians.

But the further development of alchemy took place in the west rather than in the east. With the spread of their empire to Spain the Arabs took with them their knowledge of Greek medicine and science, including alchemy, and thence it passed to the nations of western Europe, through the medium of Latin translations which began about the 11th century. The *Liber de compositione alchemiae,* which professes to be by Morienus—perhaps the same as the Marianus who, according to legend, was the teacher of Khalid—was translated by Robertus Castrensis, who states that he finished the work in 1182. The earlier translations, such as the *Turba Philosophorum* and other works printed in collections like the *Artis auriferae quam chemiam vocant* (1572), *Theatrum chemicum* (1602) and J. J. Manget's *Bibliotheca chemica curiosa* (1702), are confused productions, written in an allegorical style, but full of phrases and even pages taken literally from the Greek alchemists, and citing by name various authorities of Greek alchemy. They were followed by treatises of a different character, clearer in matter, more systematic in arrangement, and reflecting the methods of the scholastic logic. These are farther from the Greek tradition, for although they contain sufficient traces of their ultimate Greek ancestry, their authors do not know the Greeks as masters and cite no Greek names. So far as they are Latin versions of Arabico-Greek treatises, they must have been much remodelled in the course of translation; but there is reason to suppose that many of them, even when pretending to be translations, are really original compositions. It is curious that although we possess a certain number of works on alchemy written in Arabic,